Using LogMiner to Analyze Redo Log Files

Oracle LogMiner, which is part of Oracle Database, enables you to query online and archived redo log files through a SQL interface. Redo log files contain information about the history of activity on a database.

This chapter contains the following sections:

This chapter describes LogMiner as it is used from the command line. You can also access LogMiner through the Oracle LogMiner Viewer graphical user interface.Oracle LogMiner Viewer is a part of Oracle Enterprise Manager. See the Oracle Enterprise Manager online Help for more information about Oracle LogMiner Viewer.

LogMiner Benefits

All changes made to user data or to the database dictionary are recorded in the Oracle redo log files so that database recovery operations can be performed.

Because LogMiner provides a well-defined, easy-to-use, and comprehensive relational interface to redo log files, it can be used as a powerful data audit tool, as well as a tool for sophisticated data analysis. The following list describes some key capabilities of LogMiner:

- Pinpointing when a logical corruption to a database, such as errors made at the application level, may have begun. These might include errors such as those where the wrong rows were deleted because of incorrect values in a `WHERE` clause, rows were updated with incorrect values, the wrong index was dropped, and so forth. For example, a user application could mistakenly update a database to give all employees 100 percent salary increases rather than 10 percent increases, or a database administrator (DBA) could accidently delete a critical system table. It is important to know exactly when an error was made so that you know when to initiate time-based or change-based recovery. This enables you to restore the database to the state it was in just before corruption. See Querying V$LOGMNR_CONTENTS Based on Column Valuesfor details about how you can use LogMiner to accomplish this.

- Determining what actions you would have to take to perform fine-grained recovery at the transaction level. If you fully understand and take into account existing dependencies, it may be possible to perform a table-specific undo operation to return the table to its original state. This is achieved by applying table-specific reconstructed SQL statements that LogMiner provides in the reverse order from which they were originally issued. See Scenario 1: Using LogMiner to Track Changes Made by a Specific Userfor an example.

  Normally you would have to restore the table to its previous state, and then apply an archived redo log file to roll it forward.

- Performance tuning and capacity planning through trend analysis. You can determine which tables get the most updates and inserts. That information provides a historical perspective on disk access statistics, which can be used for tuning purposes. See Scenario 2: Using LogMiner to Calculate Table Access Statisticsfor an example.

- Performing postauditing. LogMiner can be used to track any data manipulation language (DML) and data definition language (DDL) statements executed on the database, the order in which they were executed, and who executed them. (However, to use LogMiner for such a purpose, you need to have an idea when the event occurred so that you can specify the appropriate logs for analysis; otherwise you might have to mine a large number of redo log files, which can take a long time. Consider using LogMiner as a complementary activity to auditing database use. See the *Oracle Database Administrator's Guide*for information about database auditing.)

Introduction to LogMiner

The following sections provide a brief introduction to LogMiner, including the following topics:

- LogMiner Configuration

- Directing LogMiner Operations and Retrieving Data of Interest

The remaining sections in this chapter describe these concepts and related topics in more detail.

LogMiner Configuration

There are four basic objects in a LogMiner configuration that you should be familiar with: the source database, the mining database, the LogMiner dictionary, and the redo log files containing the data of interest:

- The **source database** is the database that produces all the redo log files that you want LogMiner to analyze.
- The **mining database** is the database that LogMiner uses when it performs the analysis.
- The **LogMiner dictionary** allows LogMiner to provide table and column names, instead of internal object IDs, when it presents the redo log data that you request.

  LogMiner uses the dictionary to translate internal object identifiers and datatypes to object names and external data formats. Without a dictionary, LogMiner returns internal object IDs and presents data as binary data.

  For example, consider the following the SQL statement:

```
INSERT INTO HR.JOBS(JOB_ID, JOB_TITLE, MIN_SALARY, MAX_SALARY) VALUES('IT_WT','Technical Writer', 4000, 11000);
```

  Without the dictionary, LogMiner will display:

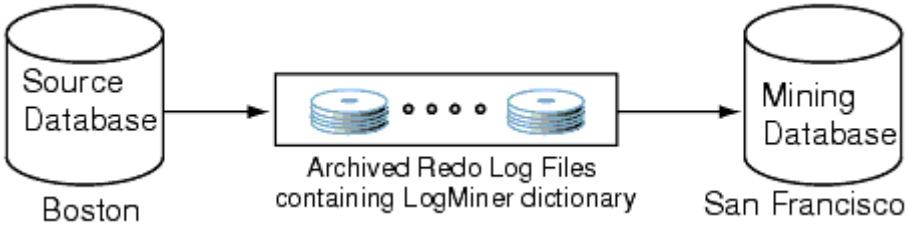
```
insert into "UNKNOWN"."OBJ# 45522"("COL 1","COL 2","COL 3","COL 4") values
(HEXTORAW('45465f4748'),HEXTORAW('546563686e6963616c20577269746572'), HEXTORAW('c229'),HEXTORAW('c3020b'));
```

- The **redo log files** contain the changes made to the database or database dictionary.

Sample Configuration

Figure 17-1shows a sample LogMiner configuration. In this figure, the source database in Boston generates redo log files that are archived and shipped to a database in San Francisco. A LogMiner dictionary has been extracted to these redo log files. The mining database, where LogMiner will actually analyze the redo log files, is in San Francisco. The Boston database is running Oracle9*i,* and the San Francisco database is running Oracle Database 10*g.*

Figure 17-1 Sample LogMiner Database Configuration



Description of the illustration remote_config.gif

Figure 17-1shows just one valid LogMiner configuration. Other valid configurations are those that use the same database for both the source and mining database, or use another method for providing the data dictionary. These other data dictionary options are described in the section about LogMiner Dictionary Options.

Requirements

The following are requirements for the source and mining database, the data dictionary, and the redo log files that LogMiner will mine:

- Source and mining database
  - Both the source database and the mining database must be running on the same hardware platform.
  - The mining database can be the same as, or completely separate from, the source database.
  - The mining database must run the same version or a later version of the Oracle Database software as the source database.
  - The mining database must use the same character set (or a superset of the character set) used by the source database.
- LogMiner dictionary
  - The dictionary must be produced by the same source database that generates the redo log files that LogMiner will analyze.
- All redo log files:
  - Must be produced by the same source database.
  - Must be associated with the same database `RESETLOGS SCN`.

- Must be from a release 8.0 or later Oracle Database. However, several of the LogMiner features introduced as of release 9.0.1 work only with redo log files produced on an Oracle9*i* or later database. See Supported Databases and Redo Log File Versions.

LogMiner does not allow you to mix redo log files from different databases or to use a dictionary from a different database than the one that generated the redo log files to be analyzed.

> **Note:**
>
> You must enable supplemental logging prior to generating log files that will be analyzed by LogMiner.
> When you enable supplemental logging, additional information is recorded in the redo stream that is needed to make the information in the redo log files useful to you. Therefore, at the very least, you must enable minimal supplemental logging, as the following SQL statement shows:
>
> ```
> ALTER DATABASE ADD SUPPLEMENTAL LOG DATA;
> ```
>
> To determine whether supplemental logging is enabled, query the `V$DATABASE` view, as the following SQL statement shows:
>
> ```
> SELECT SUPPLEMENTAL_LOG_DATA_MIN FROM V$DATABASE;
> ```
>
> If the query returns a value of `YES` or `IMPLICIT`, minimal supplemental logging is enabled. See Supplemental Loggingfor complete information about supplemental logging.

Directing LogMiner Operations and Retrieving Data of Interest

You direct LogMiner operations using the `DBMS_LOGMNR` and `DBMS_LOGMNR_D` PL/SQL packages, and retrieve data of interest using the `V$LOGMNR_CONTENTS` view, as follows:

1. Specify a LogMiner dictionary.

   Use the `DBMS_LOGMNR_D.BUILD` procedure or specify the dictionary when you start LogMiner (in Step 3), or both, depending on the type of dictionary you plan to use.

2. Specify a list of redo log files for analysis.

   Use the `DBMS_LOGMNR.ADD_LOGFILE` procedure, or direct LogMiner to create a list of log files for analysis automatically when you start LogMiner (in Step 3).

3. Start LogMiner.

   Use the `DBMS_LOGMNR.START_LOGMNR` procedure.

4. Request the redo data of interest.

   Query the `V$LOGMNR_CONTENTS` view. (You must have the `SELECT ANY TRANSACTION` privilege to query this view. Per email from Diana Lorentz/Doug Voss on 3/16/05)

5. End the LogMiner session.

   Use the `DBMS_LOGMNR.END_LOGMNR` procedure.

You must have been granted the `EXECUTE_CATALOG_ROLE` role to use the LogMiner PL/SQL packages and to query the `V$LOGMNR_CONTENTS` view.

See Also:

Steps in a Typical LogMiner Sessionfor an example of using LogMiner

LogMiner Dictionary Files and Redo Log Files

Before you begin using LogMiner, it is important to understand how LogMiner works with the LogMiner dictionary file (or files) and redo log files. This will help you to get accurate results and to plan the use of your system resources.

The following concepts are discussed in this section:

- LogMiner Dictionary Options

- Redo Log File Options

LogMiner Dictionary Options

LogMiner requires a dictionary to translate object IDs into object names when it returns redo data to you. LogMiner gives you three options for supplying the dictionary:

- Using the Online Catalog

  Oracle recommends that you use this option when you will have access to the source database from which the redo log files were created and when no changes to the column definitions in the tables of interest are anticipated. This is the most efficient and easy-to-use option.

- Extracting a LogMiner Dictionary to the Redo Log Files

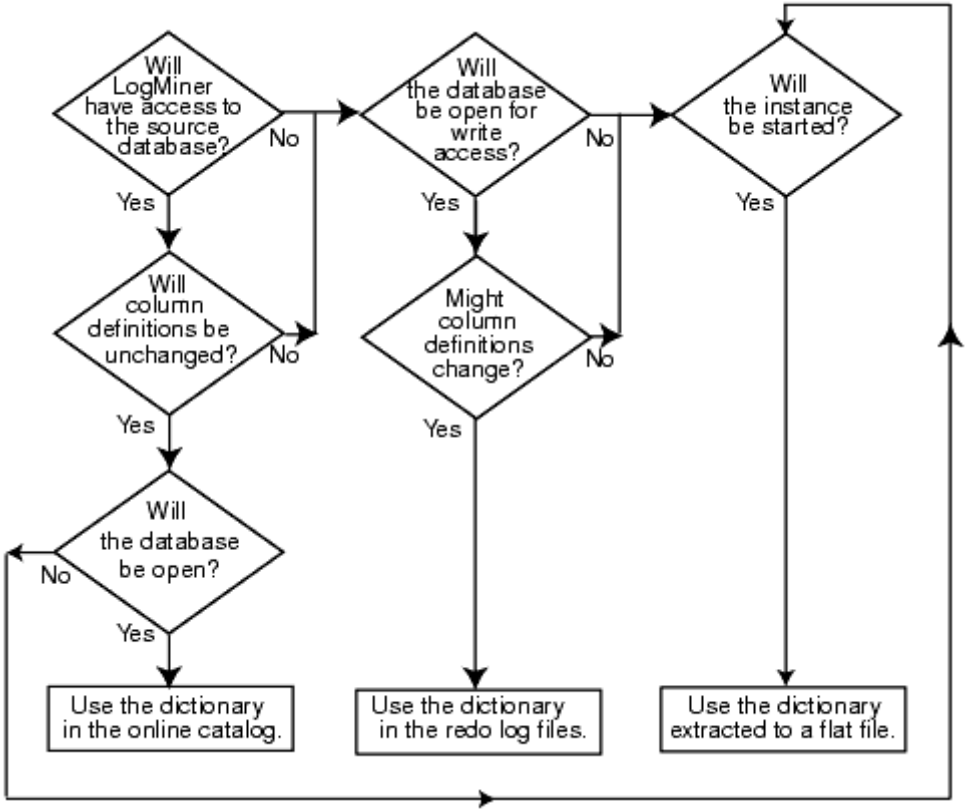
  Oracle recommends that you use this option when you do not expect to have access to the source database from which the redo log files were created, or if you anticipate that changes will be made to the column definitions in the tables of interest.

- Extracting the LogMiner Dictionary to a Flat File

  This option is maintained for backward compatibility with previous releases. This option does not guarantee transactional consistency. Oracle recommends that you use either the online catalog or extract the dictionary from redo log files instead.

Figure 17-2shows a decision tree to help you select a LogMiner dictionary, depending on your situation.

Figure 17-2 Decision Tree for Choosing a LogMiner Dictionary



Description of the illustration decision_tree.gif

The following sections provide instructions on how to specify each of the available dictionary options.

Using the Online Catalog

To direct LogMiner to use the dictionary currently in use for the database, specify the online catalog as your dictionary source when you start LogMiner, as follows:

```
EXECUTE DBMS_LOGMNR.START_LOGMNR(- OPTIONS => DBMS_LOGMNR.DICT_FROM_ONLINE_CATALOG);
```

In addition to using the online catalog to analyze online redo log files, you can use it to analyze archived redo log files, if you are on the same system that generated the archived redo log files.

The online catalog contains the latest information about the database and may be the fastest way to start your analysis. Because DDL operations that change important tables are somewhat rare, the online catalog generally contains the information you need for your analysis.

Remember, however, that the online catalog can only reconstruct SQL statements that are executed on the latest version of a table. As soon as a table is altered, the online catalog no longer reflects the previous version of the table. This means that LogMiner will not be able to reconstruct any SQL statements that were executed on the previous version of the table. Instead, LogMiner generates nonexecutable SQL (including hexadecimal-to-raw formatting of binary values) in the `SQL_REDO` column of the `V$LOGMNR_CONTENTS` view similar to the following example:

```
insert into HR.EMPLOYEES(col#1, col#2) values (hextoraw('4a6f686e20446f65'), hextoraw('c306'));"
```

The online catalog option requires that the database be open.

The online catalog option is not valid with the `DDL_DICT_TRACKING` option of `DBMS_LOGMNR.START_LOGMNR`.

Extracting a LogMiner Dictionary to the Redo Log Files

To extract a LogMiner dictionary to the redo log files, the database must be open and in `ARCHIVELOG` mode and archiving must be enabled. While the dictionary is being extracted to the redo log stream, no DDL statements can be executed. Therefore, the dictionary extracted to the redo log files is guaranteed to be consistent (whereas the dictionary extracted to a flat file is not).

To extract dictionary information to the redo log files, execute the PL/SQL `DBMS_LOGMNR_D.BUILD` procedure with the `STORE_IN_REDO_LOGS` option. Do not specify a filename or location.

```
EXECUTE DBMS_LOGMNR_D.BUILD( - OPTIONS=> DBMS_LOGMNR_D.STORE_IN_REDO_LOGS);
```

See Also:

*Oracle Database Backup and Recovery Basics*for more information about `ARCHIVELOG` mode and the *Oracle Database PL/SQL Packages and Types Reference*for a complete description of the `DBMS_LOGMNR_D.BUILD` procedure

---

The process of extracting the dictionary to the redo log files does consume database resources, but if you limit the extraction to off-peak hours, this should not be a problem, and it is faster than extracting to a flat file. Depending on the size of the dictionary, it may be contained in multiple redo log files. If the relevant redo log files have been archived, you can find out which redo log files contain the start and end of an extracted dictionary. To do so, query the `V$ARCHIVED_LOG` view, as follows:

```
SELECT NAME FROM V$ARCHIVED_LOG WHERE DICTIONARY_BEGIN='YES'; SELECT NAME FROM V$ARCHIVED_LOG WHERE DICTIONARY_END='YES';
```

Specify the names of the start and end redo log files, and possibly other logs in between them, with the `ADD_LOGFILE` procedure when you are preparing to begin a LogMiner session.

Oracle recommends that you periodically back up the redo log files so that the information is saved and available at a later date. Ideally, this will not involve any extra steps because if your database is being properly managed, there should already be a process in place for backing up and restoring archived redo log files. Again, because of the time required, it is good practice to do this during off-peak hours.

Extracting the LogMiner Dictionary to a Flat File

When the LogMiner dictionary is in a flat file, fewer system resources are used than when it is contained in the redo log files. Oracle recommends that you regularly back up the dictionary extract to ensure correct analysis of older redo log files.

To extract database dictionary information to a flat file, use the `DBMS_LOGMNR_D.BUILD` procedure with the `STORE_IN_FLAT_FILE` option.

Be sure that no DDL operations occur while the dictionary is being built.

The following steps describe how to extract a dictionary to a flat file. Steps 1 and 2 are preparation steps. You only need to do them once, and then you can extract a dictionary to a flat file as many times as you wish.

1. The `DBMS_LOGMNR_D.BUILD` procedure requires access to a directory where it can place the dictionary file. Because PL/SQL procedures do not normally access user directories, you must specify a directory for use by the `DBMS_LOGMNR_D.BUILD` procedure or the procedure will fail. To specify a directory, set the initialization parameter, `UTL_FILE_DIR`, in the initialization parameter file.

   See Also:

   *Oracle Database Reference*for more information about the initialization parameter file `(init.ora)` and the *Oracle Database PL/SQL Packages and Types Reference*for a complete description of the `DBMS_LOGMNR_D.BUILD` procedure

   For example, to set `UTL_FILE_DIR` to use `/oracle/database` as the directory where the dictionary file is placed, place the following in the initialization parameter file:

   ```
   UTL_FILE_DIR = /oracle/database
   ```

Remember that for the changes to the initialization parameter file to take effect, you must stop and restart the database.

2. If the database is closed, use SQL*Plus to mount and then open the database whose redo log files you want to analyze. For example, entering the SQL `STARTUP` command mounts and opens the database:

```
STARTUP
```

3. Execute the PL/SQL procedure `DBMS_LOGMNR_D.BUILD`. Specify a filename for the dictionary and a directory path name for the file. This procedure creates the dictionary file. For example, enter the following to create the file `dictionary.ora` in `/oracle/database`:

```
EXECUTE DBMS_LOGMNR_D.BUILD('dictionary.ora', - '/oracle/database/', - DBMS_LOGMNR_D.STORE_IN_FLAT_FILE);
```

   You could also specify a filename and location without specifying the `STORE_IN_FLAT_FILE` option. The result would be the same.

Redo Log File Options

To mine data in the redo log files, LogMiner needs information about which redo log files to mine. Changes made to the database that are found in these redo log files are delivered to you through the `V$LOGMNR_CONTENTS` view.

You can direct LogMiner to automatically and dynamically create a list of redo log files to analyze, or you can explicitly specify a list of redo log files for LogMiner to analyze, as follows:

- Automatically

  If LogMiner is being used on the source database, then you can direct LogMiner to find and create a list of redo log files for analysis automatically. Use the `CONTINUOUS_MINE` option when you start LogMiner with the `DBMS_LOGMNR.START_LOGMNR` procedure, and specify a time or SCN range. Although this example specifies the dictionary from the online catalog, any LogMiner dictionary can be used.

> **Note:**
>
> The `CONTINUOUS_MINE` option requires that the database be mounted and that archiving be enabled.

LogMiner will use the database control file to find and add redo log files that satisfy your specified time or SCN range to the LogMiner redo log file list. For example:

```
ALTER SESSION SET NLS_DATE_FORMAT = 'DD-MON-YYYY HH24:MI:SS'; EXECUTE DBMS_LOGMNR.START_LOGMNR( - STARTTIME => '01-Jan-2003
08:30:00', - ENDTIME => '01-Jan-2003 08:45:00', - OPTIONS => DBMS_LOGMNR.DICT_FROM_ONLINE_CATALOG + -
DBMS_LOGMNR.CONTINUOUS_MINE);
```

(To avoid the need to specify the date format in the PL/SQL call to the `DBMS_LOGMNR.START_LOGMNR` procedure, this example uses the SQL `ALTER SESSION SETNLS_DATE_FORMAT` statement first.)

You can also direct LogMiner to automatically build a list of redo log files to analyze by specifying just one redo log file using `DBMS_LOGMNR.ADD_LOGFILE`, and then specifying the `CONTINUOUS_MINE` option when you start LogMiner. The previously described method is more typical, however.

- Manually

  Use the `DBMS_LOGMNR.ADD_LOGFILE` procedure to manually create a list of redo log files before you start LogMiner. After the first redo log file has been added to the list, each subsequently added redo log file must be from the same database and associated with the same database RESETLOGS SCN. When using this method, LogMiner need not be connected to the source database.

  For example, to start a new list of redo log files, specify the `NEW` option of the `DBMS_LOGMNR.ADD_LOGFILE` PL/SQL procedure to signal that this is the beginning of a new list. For example, enter the following to specify `/oracle/logs/log1.f`:

  ```
  EXECUTE DBMS_LOGMNR.ADD_LOGFILE( - LOGFILENAME => '/oracle/logs/log1.f', - OPTIONS => DBMS_LOGMNR.NEW);
  ```

  If desired, add more redo log files by specifying the `ADDFILE` option of the `PL/SQL DBMS_LOGMNR.ADD_LOGFILE` procedure. For example, enter the following to add `/oracle/logs/log2.f`:

  ```
  EXECUTE DBMS_LOGMNR.ADD_LOGFILE( - LOGFILENAME => '/oracle/logs/log2.f', - OPTIONS => DBMS_LOGMNR.ADDFILE);
  ```

  To determine which redo log files are being analyzed in the current LogMiner session, you can query the `V$LOGMNR_LOGS` view, which contains one row for each redo log file.

Starting LogMiner

You call the DBMS_LOGMNR.START_LOGMNR procedure to start LogMiner. Because the options available with the DBMS_LOGMNR.START_LOGMNR procedure allow you to control output to the V$LOGMNR_CONTENTS view, you must call DBMS_LOGMNR.START_LOGMNR before querying the V$LOGMNR_CONTENTS view.

When you start LogMiner, you can:

- Specify how LogMiner should filter data it returns (for example, by starting and ending time or SCN value)
- Specify options for formatting the data returned by LogMiner
- Specify the LogMiner dictionary to use

The following list is a summary of LogMiner settings that you can specify with the OPTIONS parameter to DBMS_LOGMNR.START_LOGMNR and where to find more information about them.

- DICT_FROM_ONLINE_CATALOG — See Using the Online Catalog
- DICT_FROM_REDO_LOGS — See Start LogMiner
- CONTINUOUS_MINE — See Redo Log File Options
- COMMITTED_DATA_ONLY — See Showing Only Committed Transactions
- SKIP_CORRUPTION — See Skipping Redo Corruptions
- NO_SQL_DELIMITER — See Formatting Reconstructed SQL Statements for Reexecution
- PRINT_PRETTY_SQL — See Formatting the Appearance of Returned Data for Readability
- NO_ROWID_IN_STMT — See Formatting Reconstructed SQL Statements for Reexecution
- DDL_DICT_TRACKING — See Tracking DDL Statements in the LogMiner Dictionary

When you execute the DBMS_LOGMNR.START_LOGMNR procedure, LogMiner checks to ensure that the combination of options and parameters that you have specified is valid and that the dictionary and redo log files that you have specified are available. However, the V$LOGMNR_CONTENTS view is not populated until you query the view, as described in How the V$LOGMNR_CONTENTS View Is Populated.

Note that parameters and options are not persistent across calls to DBMS_LOGMNR.START_LOGMNR. You must specify all desired parameters and options (including SCN and time ranges) each time you call DBMS_LOGMNR.START_LOGMNR.

Querying V$LOGMNR_CONTENTS for Redo Data of Interest

You access the redo data of interest by querying the `V$LOGMNR_CONTENTS` view. (Note that you must have the `SELECT ANY TRANSACTION` privilege to query `V$LOGMNR_CONTENTS`.) Per email from Diana Lorentz/Doug Voss on 3/16/05This view provides historical information about changes made to the database, including (but not limited to) the following:

- The type of change made to the database: `INSERT`, `UPDATE`, `DELETE`, or `DDL` (`OPERATION` column).
- The SCN at which a change was made (`SCN` column).
- The SCN at which a change was committed (`COMMIT_SCN` column).
- The transaction to which a change belongs (`XIDUSN`, `XIDSLT`, and `XIDSQN` columns).
- The table and schema name of the modified object (`SEG_NAME` and `SEG_OWNER` columns).
- The name of the user who issued the DDL or DML statement to make the change (`USERNAME` column).
- If the change was due to a SQL DML statement, the reconstructed SQL statements showing SQL DML that is equivalent (but not necessarily identical) to the SQL DML used to generate the redo records (`SQL_REDO` column).
- If a password is part of the statement in a `SQL_REDO` column, the password is encrypted. `SQL_REDO` column values that correspond to DDL statements are always identical to the SQL DDL used to generate the redo records.
- If the change was due to a SQL DML change, the reconstructed SQL statements showing the SQL DML statements needed to undo the change (`SQL_UNDO` column).

  `SQL_UNDO` columns that correspond to DDL statements are always `NULL`. The `SQL_UNDO` column may be `NULL` also for some datatypes and for rolled back operations.

For example, suppose you wanted to find out about any delete operations that a user named Ron had performed on the `oe.orders` table. You could issue a SQL query similar to the following:

```
SELECT OPERATION, SQL_REDO, SQL_UNDO FROM V$LOGMNR_CONTENTS WHERE SEG_OWNER = 'OE' AND SEG_NAME = 'ORDERS' AND OPERATION =
'DELETE' AND USERNAME = 'RON';
```

The following output would be produced. The formatting may be different on your display than that shown here.

```
OPERATION SQL_REDO SQL_UNDO DELETE delete from "OE"."ORDERS" insert into "OE"."ORDERS" where "ORDER_ID" = '2413'
("ORDER_ID","ORDER_MODE", and "ORDER_MODE" = 'direct' "CUSTOMER_ID","ORDER_STATUS", and "CUSTOMER_ID" = '101'
"ORDER_TOTAL","SALES_REP_ID", and "ORDER_STATUS" = '5' "PROMOTION_ID") and "ORDER_TOTAL" = '48552' values ('2413','direct','101',
and "SALES_REP_ID" = '161' '5','48552','161',NULL); and "PROMOTION_ID" IS NULL and ROWID = 'AAAHTCAABAAAZAPAAN'; DELETE delete
from "OE"."ORDERS" insert into "OE"."ORDERS" where "ORDER_ID" = '2430' ("ORDER_ID","ORDER_MODE", and "ORDER_MODE" = 'direct'
"CUSTOMER_ID","ORDER_STATUS", and "CUSTOMER_ID" = '101' "ORDER_TOTAL","SALES_REP_ID", and "ORDER_STATUS" = '8' "PROMOTION_ID") and
"ORDER_TOTAL" = '29669.9' values('2430','direct','101', and "SALES_REP_ID" = '159' '8','29669.9','159',NULL); and "PROMOTION_ID"
IS NULL and ROWID = 'AAAHTCAABAAAZAPAAe';
```

This output shows that user Ron deleted two rows from the `oe.orders` table. The reconstructed SQL statements are equivalent, but not necessarily identical, to the actual statement that Ron issued. The reason for this is that the original `WHERE` clause is not logged in the redo log files, so LogMiner can only show deleted (or updated or inserted) rows individually.

Therefore, even though a single `DELETE` statement may have been responsible for the deletion of both rows, the output in `V$LOGMNR_CONTENTS` does not reflect that. Thus, the actual `DELETE` statement may have been `DELETE FROM OE.ORDERS WHERE CUSTOMER_ID ='101'` or it might have been `DELETE FROM OE.ORDERS WHERE PROMOTION_ID = NULL.`

How the V$LOGMNR_CONTENTS View Is Populated

The `V$LOGMNR_CONTENTS` fixed view is unlike other views in that it is not a selective presentation of data stored in a table. Instead, it is a relational presentation of the data that you request from the redo log files. LogMiner populates the view only in response to a query against it. You must successfully start LogMiner before you can query `V$LOGMNR_CONTENTS`.

When a SQL select operation is executed against the `V$LOGMNR_CONTENTS` view, the redo log files are read sequentially. Translated information from the redo log files is returned as rows in the `V$LOGMNR_CONTENTS` view. This continues until either the filter criteria specified at startup are met or the end of the redo log file is reached.

In some cases, certain columns in `V$LOGMNR_CONTENTS` may not be populated. For example:

- The `TABLE_SPACE` column is not populated for rows where the value of the `OPERATION` column is `DDL`. This is because a DDL may operate on more than one tablespace. For example, a table can be created with multiple partitions spanning multiple table spaces; hence it would not be accurate to populate the column.

- LogMiner does not generate SQL redo or SQL undo for temporary tables. The `SQL_REDO` column will contain the string `"/* No SQL_REDO for temporary tables */"` and the `SQL_UNDO` column will contain the string `"/* No SQL_UNDO for temporary tables */"`.

LogMiner returns all the rows in SCN order unless you have used the `COMMITTED_DATA_ONLY` option to specify that only committed transactions should be retrieved. SCN order is the order normally applied in media recovery.

> **See Also:**
>
> Showing Only Committed Transactionsfor more information about the `COMMITTED_DATA_ONLY` option to `DBMS_LOGMNR.START_LOGMNR`

> **Note:**
>
> Because LogMiner populates the `V$LOGMNR_CONTENTS` view only in response to a query and does not store the requested data in the database, the following is true:
>
> - Every time you query `V$LOGMNR_CONTENTS`, LogMiner analyzes the redo log files for the data you request.
> - The amount of memory consumed by the query is not dependent on the number of rows that must be returned to satisfy a query.
> - The time it takes to return the requested data is dependent on the amount and type of redo log data that must be mined to find that data.

For the reasons stated in the previous note, Oracle recommends that you create a table to temporarily hold the results from a query of `V$LOGMNR_CONTENTS` if you need to maintain the data for further analysis, particularly if the amount of data returned by a query is small in comparison to the amount of redo data that LogMiner must analyze to provide that data.

Querying V$LOGMNR_CONTENTS Based on Column Values

LogMiner lets you make queries based on column values. For instance, you can perform a query to show all updates to the `hr.employees` table that increase `salary`more than a certain amount. Data such as this can be used to analyze system behavior and to perform auditing tasks.

LogMiner data extraction from redo log files is performed using two mine functions: `DBMS_LOGMNR.MINE_VALUE` and `DBMS_LOGMNR.COLUMN_PRESENT`. Support for these mine functions is provided by the `REDO_VALUE` and `UNDO_VALUE` columns in the `V$LOGMNR_CONTENTS` view.

The following is an example of how you could use the `MINE_VALUE` function to select all updates to `hr.employees` that increased the `salary` column to more than twice its original value:

```
SELECT SQL_REDO FROM V$LOGMNR_CONTENTS WHERE SEG_NAME = 'EMPLOYEES' AND SEG_OWNER = 'HR' AND OPERATION = 'UPDATE' AND
DBMS_LOGMNR.MINE_VALUE(REDO_VALUE, 'HR.EMPLOYEES.SALARY') > 2*DBMS_LOGMNR.MINE_VALUE(UNDO_VALUE, 'HR.EMPLOYEES.SALARY');
```

As shown in this example, the `MINE_VALUE` function takes two arguments:

- The first one specifies whether to mine the redo (`REDO_VALUE`) or undo (`UNDO_VALUE`) portion of the data. The redo portion of the data is the data that is in the column after an insert, update, or delete operation; the undo portion of the data is the data that was in the column before an insert, update, or delete operation. It may help to think of the `REDO_VALUE` as the new value and the `UNDO_VALUE` as the old value.

- The second argument is a string that specifies the fully qualified name of the column to be mined (in this case, `hr.employees.salary`). The `MINE_VALUE` function always returns a string that can be converted back to the original datatype.

The Meaning of NULL Values Returned by the MINE_VALUE Function

If the `MINE_VALUE` function returns a `NULL` value, it can mean either:

- The specified column is not present in the redo or undo portion of the data.

- The specified column is present and has a null value.

To distinguish between these two cases, use the `DBMS_LOGMNR.COLUMN_PRESENT` function which returns a `1` if the column is present in the redo or undo portion of the data. Otherwise, it returns a `0`. For example, suppose you wanted to find out the increment by which the values in the `salary` column were modified and the corresponding transaction identifier. You could issue the following SQL query:

```
SELECT (XIDUSN || '.' || XIDSLT || '.' || XIDSQN) AS XID, (DBMS_LOGMNR.MINE_VALUE(REDO_VALUE, 'HR.EMPLOYEES.SALARY') -
DBMS_LOGMNR.MINE_VALUE(UNDO_VALUE, 'HR.EMPLOYEES.SALARY')) AS INCR_SAL FROM V$LOGMNR_CONTENTS WHERE OPERATION = 'UPDATE' AND
DBMS_LOGMNR.COLUMN_PRESENT(REDO_VALUE, 'HR.EMPLOYEES.SALARY') = 1 AND DBMS_LOGMNR.COLUMN_PRESENT(UNDO_VALUE,
'HR.EMPLOYEES.SALARY') = 1;
```

Usage Rules for the MINE_VALUE and COLUMN_PRESENT Functions

The following usage rules apply to the `MINE_VALUE` and `COLUMN_PRESENT` functions:

- They can only be used within a LogMiner session.
- They must be invoked in the context of a select operation from the `V$LOGMNR_CONTENTS` view.
- They do not support `LONG`, `LONG RAW`, `CLOB`, `BLOB`, `NCLOB`, `ADT`, or `COLLECTION` datatypes.

See Also:

Oracle Database PL/SQL Packages and Types Reference for a description of the `DBMS_LOGMNR` package, which contains the `MINE_VALUE` and `COLUMN_PRESENT` functions

Filtering and Formatting Data Returned to V$LOGMNR_CONTENTS

LogMiner can potentially deal with large amounts of information. You can limit the information that is returned to the `V$LOGMNR_CONTENTS` view, and the speed at which it is returned. The following sections demonstrate how to specify these limits and their impact on the data returned when you query `V$LOGMNR_CONTENTS`.

In addition, LogMiner offers features for formatting the data that is returned to V$LOGMNR_CONTENTS, as described in the following sections:

- Formatting Reconstructed SQL Statements for Reexecution
- Formatting the Appearance of Returned Data for Readability

You request each of these filtering and formatting features using parameters or options to the DBMS_LOGMNR.START_LOGMNR procedure.

Showing Only Committed Transactions

When you use the COMMITTED_DATA_ONLY option to DBMS_LOGMNR.START_LOGMNR, only rows belonging to committed transactions are shown in the V$LOGMNR_CONTENTS view. This enables you to filter out rolled back transactions, transactions that are in progress, and internal operations.

To enable this option, specify it when you start LogMiner, as follows:

```
EXECUTE DBMS_LOGMNR.START_LOGMNR(OPTIONS => - DBMS_LOGMNR.COMMITTED_DATA_ONLY);
```

When you specify the COMMITTED_DATA_ONLY option, LogMiner groups together all DML operations that belong to the same transaction. Transactions are returned in the order in which they were committed.

> **Note:**
>
> If the COMMITTED_DATA_ONLY option is specified and you issue a query, LogMiner stages all redo records within a single transaction in memory until LogMiner finds the commit record for that transaction. Therefore, it is possible to exhaust memory, in which case an "Out of Memory" error will be returned. If this occurs, you must restart LogMiner without the COMMITTED_DATA_ONLYoption specified and reissue the query.

The default is for LogMiner to show rows corresponding to all transactions and to return them in the order in which they are encountered in the redo log files.

For example, suppose you start LogMiner without specifying the COMMITTED_DATA_ONLY option and you execute the following query:

```
SELECT (XIDUSN || '.' || XIDSLT || '.' || XIDSQN) AS XID, USERNAME, SQL_REDO FROM V$LOGMNR_CONTENTS WHERE USERNAME != 'SYS' AND
SEG_OWNER IS NULL OR SEG_OWNER NOT IN ('SYS', 'SYSTEM');
```

The output is as follows. Both committed and uncommitted transactions are returned and rows from different transactions are interwoven.

```
XID USERNAME SQL_REDO 1.15.3045 RON set transaction read write; 1.15.3045 RON insert into "HR"."JOBS"("JOB_ID","JOB_TITLE",
"MIN_SALARY","MAX_SALARY") values ('9782', 'HR_ENTRY',NULL,NULL); 1.18.3046 JANE set transaction read write; 1.18.3046 JANE insert
into "OE"."CUSTOMERS"("CUSTOMER_ID", "CUST_FIRST_NAME","CUST_LAST_NAME", "CUST_ADDRESS","PHONE_NUMBERS","NLS_LANGUAGE",
"NLS_TERRITORY","CREDIT_LIMIT","CUST_EMAIL", "ACCOUNT_MGR_ID") values ('9839','Edgar', 'Cummings',NULL,NULL,NULL,NULL,
NULL,NULL,NULL); 1.9.3041 RAJIV set transaction read write; 1.9.3041 RAJIV insert into "OE"."CUSTOMERS"("CUSTOMER_ID",
"CUST_FIRST_NAME","CUST_LAST_NAME","CUST_ADDRESS", "PHONE_NUMBERS","NLS_LANGUAGE","NLS_TERRITORY",
"CREDIT_LIMIT","CUST_EMAIL","ACCOUNT_MGR_ID") values ('9499','Rodney','Emerson',NULL,NULL,NULL,NULL, NULL,NULL,NULL); 1.15.3045
RON commit; 1.8.3054 RON set transaction read write; 1.8.3054 RON insert into "HR"."JOBS"("JOB_ID","JOB_TITLE",
"MIN_SALARY","MAX_SALARY") values ('9566', 'FI_ENTRY',NULL,NULL); 1.18.3046 JANE commit; 1.11.3047 JANE set transaction read
write; 1.11.3047 JANE insert into "OE"."CUSTOMERS"("CUSTOMER_ID", "CUST_FIRST_NAME","CUST_LAST_NAME",
"CUST_ADDRESS","PHONE_NUMBERS","NLS_LANGUAGE", "NLS_TERRITORY","CREDIT_LIMIT","CUST_EMAIL", "ACCOUNT_MGR_ID") values
('8933','Ronald', 'Frost',NULL,NULL,NULL,NULL,NULL,NULL,NULL); 1.11.3047 JANE commit; 1.8.3054 RON commit;
```

Now suppose you start LogMiner, but this time you specify the `COMMITTED_DATA_ONLY` option. If you execute the previous query again, the output is as follows:

```
1.15.3045 RON set transaction read write; 1.15.3045 RON insert into "HR"."JOBS"("JOB_ID","JOB_TITLE", "MIN_SALARY","MAX_SALARY")
values ('9782', 'HR_ENTRY',NULL,NULL); 1.15.3045 RON commit; 1.18.3046 JANE set transaction read write; 1.18.3046 JANE insert into
"OE"."CUSTOMERS"("CUSTOMER_ID", "CUST_FIRST_NAME","CUST_LAST_NAME", "CUST_ADDRESS","PHONE_NUMBERS","NLS_LANGUAGE",
"NLS_TERRITORY","CREDIT_LIMIT","CUST_EMAIL", "ACCOUNT_MGR_ID") values ('9839','Edgar', 'Cummings',NULL,NULL,NULL,NULL,
NULL,NULL,NULL); 1.18.3046 JANE commit; 1.11.3047 JANE set transaction read write; 1.11.3047 JANE insert into "OE"."CUSTOMERS"
("CUSTOMER_ID", "CUST_FIRST_NAME","CUST_LAST_NAME", "CUST_ADDRESS","PHONE_NUMBERS","NLS_LANGUAGE",
"NLS_TERRITORY","CREDIT_LIMIT","CUST_EMAIL", "ACCOUNT_MGR_ID") values ('8933','Ronald',
'Frost',NULL,NULL,NULL,NULL,NULL,NULL,NULL); 1.11.3047 JANE commit; 1.8.3054 RON set transaction read write; 1.8.3054 RON insert
into "HR"."JOBS"("JOB_ID","JOB_TITLE", "MIN_SALARY","MAX_SALARY") values ('9566', 'FI_ENTRY',NULL,NULL); 1.8.3054 RON commit;
```

Because the `COMMIT` statement for the 1.15.3045 transaction was issued before the `COMMIT` statement for the 1.18.3046 transaction, the entire 1.15.3045 transaction is returned first. This is true even though the 1.18.3046 transaction started before the 1.15.3045 transaction. None of the 1.9.3041 transaction is returned because a `COMMIT` statement was never issued for it.

See Also:

See Examples Using LogMinerfor a complete example that uses the `COMMITTED_DATA_ONLY` option

Skipping Redo Corruptions

When you use the `SKIP_CORRUPTION` option to `DBMS_LOGMNR.START_LOGMNR`, any corruptions in the redo log files are skipped during select operations from the `V$LOGMNR_CONTENTS` view. For every corrupt redo record encountered, a row is returned that contains the value `CORRUPTED_BLOCKS` in the `OPERATION` column, `1343` in the `STATUS` column, and the number of blocks skipped in the `INFO` column.

Be aware that the skipped records may include changes to ongoing transactions in the corrupted blocks; such changes will not be reflected in the data returned from the `V$LOGMNR_CONTENTS` view.

The default is for the select operation to terminate at the first corruption it encounters in the redo log file.

The following SQL example shows how this option works:

```
-- Add redo log files of interest. -- EXECUTE DBMS_LOGMNR.ADD_LOGFILE(- logfilename =>
'/usr/oracle/data/db1arch_1_16_482701534.log' - options => DBMS_LOGMNR.NEW); -- Start LogMiner -- EXECUTE
DBMS_LOGMNR.START_LOGMNR(); -- Select from the V$LOGMINER_CONTENTS view. This example shows corruptions are -- in the redo log
files. -- SELECT rbasqn, rbablk, rbabyte, operation, status, info FROM V$LOGMNR_CONTENTS; ERROR at line 3: ORA-00368: checksum
error in redo log block ORA-00353: log corruption near block 6 change 73528 time 11/06/2002 11:30:23 ORA-00334: archived log:
/usr/oracle/data/dbarch1_16_482701534.log -- Restart LogMiner. This time, specify the SKIP_CORRUPTION option. -- EXECUTE
DBMS_LOGMNR.START_LOGMNR(- options => DBMS_LOGMNR.SKIP_CORRUPTION); -- Select from the V$LOGMINER_CONTENTS view again. The output
indicates that -- corrupted blocks were skipped: CORRUPTED_BLOCKS is in the OPERATION -- column, 1343 is in the STATUS column, and
the number of corrupt blocks -- skipped is in the INFO column. -- SELECT rbasqn, rbablk, rbabyte, operation, status, info FROM
V$LOGMNR_CONTENTS; RBASQN RBABLK RBABYTE OPERATION STATUS INFO 13 2 76 START 0 13 2 76 DELETE 0 13 3 100 INTERNAL 0 13 3 380
DELETE 0 13 0 0 CORRUPTED_BLOCKS 1343 corrupt blocks 4 to 19 skipped 13 20 116 UPDATE 0
```

Filtering Data by Time

To filter data by time, set the `STARTTIME` and `ENDTIME` parameters in the `DBMS_LOGMNR.START_LOGMNR` procedure.

To avoid the need to specify the date format in the call to the PL/SQL `DBMS_LOGMNR.START_LOGMNR` procedure, you can use the SQL `ALTER SESSION SET NLS_DATE_FORMAT` statement first, as shown in the following example.

```
ALTER SESSION SET NLS_DATE_FORMAT = 'DD-MON-YYYY HH24:MI:SS'; EXECUTE DBMS_LOGMNR.START_LOGMNR( - DICTFILENAME =>
'/oracle/database/dictionary.ora', - STARTTIME => '01-Jan-1998 08:30:00', - ENDTIME => '01-Jan-1998 08:45:00'- OPTIONS =>
DBMS_LOGMNR.CONTINUOUS_MINE);
```

The timestamps should not be used to infer ordering of redo records. You can infer the order of redo records by using the SCN.

See Also:

- Examples Using LogMinerfor a complete example of filtering data by time
- *Oracle Database PL/SQL Packages and Types Reference*for information about what happens if you specify starting and ending times and they are not found in the LogMiner redo log file list, and for information about how these parameters interact with the `CONTINUOUS_MINE` option

---

Filtering Data by SCN

To filter data by SCN (system change number), use the `STARTSCN` and `ENDSCN` parameters to the PL/SQL `DBMS_LOGMNR.START_LOGMNR` procedure, as shown in this example:

```
EXECUTE DBMS_LOGMNR.START_LOGMNR(- STARTSCN => 621047, - ENDSCN => 625695, - OPTIONS => DBMS_LOGMNR.DICT_FROM_ONLINE_CATALOG + -
DBMS_LOGMNR.CONTINUOUS_MINE);
```

The `STARTSCN` and `ENDSCN` parameters override the `STARTTIME` and `ENDTIME` parameters in situations where all are specified.

See Also:

- Examples Using LogMinerfor a complete example of filtering data by SCN
- *Oracle Database PL/SQL Packages and Types Reference*for information about what happens if you specify starting and ending SCN values and they are not found in the LogMiner redo log file list and for information about how these parameters interact with the `CONTINUOUS_MINE` option

---

Formatting Reconstructed SQL Statements for Reexecution

By default, a `ROWID` clause is included in the reconstructed `SQL_REDO` and `SQL_UNDO` statements and the statements are ended with a semicolon.

However, you can override the default settings, as follows:

- Specify the `NO_ROWID_IN_STMT` option when you start LogMiner.

  This excludes the `ROWID` clause from the reconstructed statements. Because row IDs are not consistent between databases, if you intend to reexecute the `SQL_REDO`or `SQL_UNDO` statements against a different database than the one against which they were originally executed, specify the `NO_ROWID_IN_STMT` option when you start LogMiner.

- Specify the `NO_SQL_DELIMITER` option when you start LogMiner.

  This suppresses the semicolon from the reconstructed statements. This is helpful for applications that open a cursor and then execute the reconstructed statements.

Note that if the `STATUS` field of the `V$LOGMNR_CONTENTS` view contains the value `2` (`invalid sql`), then the associated SQL statement cannot be executed.

Formatting the Appearance of Returned Data for Readability

Sometimes a query can result in a large number of columns containing reconstructed SQL statements, which can be visually busy and hard to read. LogMiner provides the `PRINT_PRETTY_SQL` option to address this problem. The `PRINT_PRETTY_SQL` option to the `DBMS_LOGMNR.START_LOGMNR` procedure formats the reconstructed SQL statements as follows, which makes them easier to read:

```
insert into "HR"."JOBS" values "JOB_ID" = '9782', "JOB_TITLE" = 'HR_ENTRY', "MIN_SALARY" IS NULL, "MAX_SALARY" IS NULL; update
"HR"."JOBS" set "JOB_TITLE" = 'FI_ENTRY' where "JOB_TITLE" = 'HR_ENTRY' and ROWID = 'AAAHSeAABAAAY+CAAX'; update "HR"."JOBS" set
"JOB_TITLE" = 'FI_ENTRY' where "JOB_TITLE" = 'HR_ENTRY' and ROWID = 'AAAHSeAABAAAY+CAAX'; delete from "HR"."JOBS" where "JOB_ID" =
'9782' and "JOB_TITLE" = 'FI_ENTRY' and "MIN_SALARY" IS NULL and "MAX_SALARY" IS NULL and ROWID = 'AAAHSeAABAAAY+CAAX';
```

SQL statements that are reconstructed when the `PRINT_PRETTY_SQL` option is enabled are not executable, because they do not use standard SQL syntax.

See Also:

Examples Using LogMinerfor a complete example of using the `PRINT_PRETTY_SQL` option

Reapplying DDL Statements Returned to V$LOGMNR_CONTENTS

Be aware that some DDL statements issued by a user cause Oracle to internally execute one or more other DDL statements. If you want to reapply SQL DDL from the `SQL_REDO` or `SQL_UNDO` columns of the `V$LOGMNR_CONTENTS` view as it was originally applied to the database, you should not execute statements that were executed internally by Oracle.

Note:

If you execute DML statements that were executed internally by Oracle you may corrupt your database. See Step 5 of Example 4: Using the LogMiner Dictionary in the Redo Log Filesfor an example.

To differentiate between DDL statements that were issued by a user from those that were issued internally by Oracle, query the `INFO` column of `V$LOGMNR_CONTENTS`. The value of the `INFO` column indicates whether the DDL was executed by a user or by Oracle.

If you want to reapply SQL DDL as it was originally applied, you should only reexecute the DDL SQL contained in the SQL_REDO or SQL_UNDO column of V$LOGMNR_CONTENTS if the INFO column contains the value USER_DDL.

Calling DBMS_LOGMNR.START_LOGMNR Multiple Times

Even after you have successfully called DBMS_LOGMNR.START_LOGMNR and selected from the V$LOGMNR_CONTENTS view, you can call DBMS_LOGMNR.START_LOGMNRagain without ending the current LogMiner session and specify different options and time or SCN ranges. The following list presents reasons why you might want to do this:

- You want to limit the amount of redo data that LogMiner has to analyze.
- You want to specify different options. For example, you might decide to specify the PRINT_PRETTY_SQL option or that you only want to see committed transactions (so you specify the COMMITTED_DATA_ONLY option).
- You want to change the time or SCN range to be analyzed.

The following examples illustrate situations where it might be useful to call DBMS_LOGMNR.START_LOGMNR multiple times.

Example 1 Mining Only a Subset of the Data in the Redo Log Files

Suppose the list of redo log files that LogMiner has to mine include those generated for an entire week. However, you want to analyze only what happened from 12:00 to 1:00 each day. You could do this most efficiently by:

1. Calling DBMS_LOGMNR.START_LOGMNR with this time range for Monday.
2. Selecting changes from the V$LOGMNR_CONTENTS view.
3. Repeating Steps 1 and 2 for each day of the week.

If the total amount of redo data is large for the week, then this method would make the whole analysis much faster, because only a small subset of each redo log file in the list would be read by LogMiner.

Example 1 Adjusting the Time Range or SCN Range

Suppose you specify a redo log file list and specify a time (or SCN) range when you start LogMiner. When you query the `V$LOGMNR_CONTENTS` view, you find that only part of the data of interest is included in the time range you specified. You can call `DBMS_LOGMNR.START_LOGMNR` again to expand the time range by an hour (or adjust the SCN range).

Example 2 Analyzing Redo Log Files As They Arrive at a Remote Database

Suppose you have written an application to analyze changes or to replicate changes from one database to another database. The source database sends its redo log files to the mining database and drops them into an operating system directory. Your application:

1. Adds all redo log files currently in the directory to the redo log file list
2. Calls `DBMS_LOGMNR.START_LOGMNR` with appropriate settings and selects from the `V$LOGMNR_CONTENTS` view
3. Adds additional redo log files that have newly arrived in the directory
4. Repeats Steps 2 and 3, indefinitely

Supplemental Logging

Redo log files are generally used for instance recovery and media recovery. The data needed for such operations is automatically recorded in the redo log files. However, a redo-based application may require that additional columns be logged in the redo log files. The process of logging these additional columns is called **supplemental logging.**

By default, Oracle Database does not provide any supplemental logging, which means that by default LogMiner is not usable. Therefore, you must enable at least minimal supplemental logging prior to generating log files which will be analyzed by LogMiner.

The following are examples of situations in which additional columns may be needed:

- An application that applies reconstructed SQL statements to a different database must identify the update statement by a set of columns that uniquely identify the row (for example, a primary key), not by the `ROWID` shown in the reconstructed SQL returned by the `V$LOGMNR_CONTENTS` view, because the `ROWID` of one database will be different and therefore meaningless in another database.
- An application may require that the before-image of the whole row be logged, not just the modified columns, so that tracking of row changes is more efficient.

A **supplemental log group** is the set of additional columns to be logged when supplemental logging is enabled. There are two types of supplemental log groups that determine when columns in the log group are logged:

- **Unconditional supplemental log groups:** The before-images of specified columns are logged any time a row is updated, regardless of whether the update affected any of the specified columns. This is sometimes referred to as an ALWAYS log group.
- **Conditional supplemental log groups:** The before-images of all specified columns are logged only if at least one of the columns in the log group is updated.

Supplemental log groups can be system-generated or user-defined.

In addition to the two types of supplemental logging, there are two levels of supplemental logging, as described in the following sections:

- Database-Level Supplemental Logging
- Table-Level Supplemental Logging

See Also:

Querying Views for Supplemental Logging Settings

Database-Level Supplemental Logging

There are two types of database-level supplemental logging: minimal supplemental logging and identification key logging, as described in the following sections. Minimal supplemental logging does not impose significant overhead on the database generating the redo log files. However, enabling database-wide identification key logging can impose overhead on the database generating the redo log files. Oracle recommends that you at least enable minimal supplemental logging for LogMiner.

Minimal Supplemental Logging

Minimal supplemental logging logs the minimal amount of information needed for LogMiner to identify, group, and merge the redo operations associated with DML changes. It ensures that LogMiner (and any product building on LogMiner technology) has sufficient information to support chained rows and various storage arrangements, such as cluster tables and index-organized tables. To enable minimal supplemental logging, execute the following SQL statement:

```
ALTER DATABASE ADD SUPPLEMENTAL LOG DATA;
```

Note:

In Oracle Database release 9.0.1, minimal supplemental logging was the default behavior in LogMiner. In release 9.2 and later, the default is no supplemental logging. Supplemental logging must be specifically enabled.

Database-Level Identification Key Logging

Identification key logging is necessary when redo log files will not be mined at the source database instance, for example, when the redo log files will be mined at a logical standby database.

Using database identification key logging, you can enable database-wide before-image logging for all updates by specifying one or more of the following options to the SQL `ALTER DATABASE ADD SUPPLEMENTAL LOG` statement:

- `ALL` system-generated unconditititional supplemental log group

  This option specifies that when a row is updated, all columns of that row (except for LOBs, `LONGS`, and `ADT`s) are placed in the redo log file.

  To enable all column logging at the database level, execute the following statement:

  ```
  SQL> ALTER DATABASE ADD SUPPLEMENTAL LOG DATA (ALL) COLUMNS;
  ```

- `PRIMARY KEY` system-generated unconditititional supplemental log group

  This option causes the database to place all columns of a row's primary key in the redo log file whenever a row containing a primary key is updated (even if no value in the primary key has changed).

  If a table does not have a primary key, but has one or more non-null unique index key constraints or index keys, then one of the unique index keys is chosen for logging as a means of uniquely identifying the row being updated.

If the table has neither a primary key nor a non-null unique index key, then all columns except `LONG` and LOB are supplementally logged; this is equivalent to specifying `ALL` supplemental logging for that row. Therefore, Oracle recommends that when you use database-level primary key supplemental logging, all or most tables be defined to have primary or unique index keys.

To enable primary key logging at the database level, execute the following statement:

```
SQL> ALTER DATABASE ADD SUPPLEMENTAL LOG DATA (PRIMARY KEY) COLUMNS;
```

- UNIQUE system-generated conditional supplemental log group

  This option causes the database to place all columns of a row's composite unique key or bitmap index in the redo log file if any column belonging to the composite unique key or bitmap index is modified. The unique key can be due to either a unique constraint or a unique index.

  To enable unique index key and bitmap index logging at the database level, execute the following statement:

```
SQL> ALTER DATABASE ADD SUPPLEMENTAL LOG DATA (UNIQUE) COLUMNS;
```

- `FOREIGN KEY` system-generated conditional supplemental log group

  This option causes the database to place all columns of a row's foreign key in the redo log file if any column belonging to the foreign key is modified.

  To enable foreign key logging at the database level, execute the following SQL statement:

```
ALTER DATABASE ADD SUPPLEMENTAL LOG DATA (FOREIGN KEY) COLUMNS;
```

Note:

Regardless of whether or not identification key logging is enabled, the SQL statements returned by LogMiner always contain the `ROWID` clause. You can filter out the `ROWID` clause by using the `NO_ROWID_IN_STMT` option to the `DBMS_LOGMNR.START_LOGMNR`procedure call. See Formatting Reconstructed SQL Statements for Reexecutionfor details.

Keep the following in mind when you use identification key logging:

- If the database is open when you enable identification key logging, all DML cursors in the cursor cache are invalidated. This can affect performance until the cursor cache is repopulated.
- When you enable identification key logging at the database level, minimal supplemental logging is enabled implicitly.
- Supplemental logging statements are cumulative. If you issue the following SQL statements, both primary key and unique key supplemental logging is enabled:

```
ALTER DATABASE ADD SUPPLEMENTAL LOG DATA (PRIMARY KEY) COLUMNS; ALTER DATABASE ADD SUPPLEMENTAL LOG DATA (UNIQUE) COLUMNS;
```

Disabling Database-Level Supplemental Logging

You disable database-level supplemental logging using the SQL `ALTER DATABASE` statement with the `DROP SUPPLEMENTAL LOGGING` clause. You can drop supplemental logging attributes incrementally. For example, suppose you issued the following SQL statements, in the following order:

```
ALTER DATABASE ADD SUPPLEMENTAL LOG DATA (PRIMARY KEY) COLUMNS; ALTER DATABASE ADD SUPPLEMENTAL LOG DATA (UNIQUE) COLUMNS; ALTER DATABASE DROP SUPPLEMENTAL LOG DATA (PRIMARY KEY) COLUMNS; ALTER DATABASE DROP SUPPLEMENTAL LOG DATA;
```

The statements would have the following effects:

- After the first statement, primary key supplemental logging is enabled.
- After the second statement, primary key and unique key supplemental logging are enabled.
- After the third statement, only unique key supplemental logging is enabled.
- After the fourth statement, all supplemental logging is not disabled. The following error is returned: `ORA-32589: unable to drop minimal supplemental logging.`

To disable all database supplemental logging, you must first disable any identification key logging that has been enabled, then disable minimal supplemental logging. The following example shows the correct order:

```
ALTER DATABASE ADD SUPPLEMENTAL LOG DATA (PRIMARY KEY) COLUMNS; ALTER DATABASE ADD SUPPLEMENTAL LOG DATA (UNIQUE) COLUMNS; ALTER DATABASE DROP SUPPLEMENTAL LOG DATA (PRIMARY KEY) COLUMNS; ALTER DATABASE DROP SUPPLEMENTAL LOG DATA (UNIQUE) COLUMNS; ALTER DATABASE DROP SUPPLEMENTAL LOG DATA;
```

Dropping minimal supplemental log data is allowed only if no other variant of database-level supplemental logging is enabled.

Table-Level Supplemental Logging

Table-level supplemental logging specifies, at the table level, which columns are to be supplementally logged. You can use identification key logging or user-defined conditional and unconditional supplemental log groups to log supplemental information, as described in the following sections.

Table-Level Identification Key Logging

Identification key logging at the table level offers the same options as those provided at the database level: all, primary key, foreign key, and unique key. However, when you specify identification key logging at the table level, only the specified table is affected. For example, if you enter the following SQL statement (specifying database-level supplemental logging), then whenever a column in any database table is changed, the entire row containing that column (except columns for LOBs, `LONG`s, and `ADT`s) will be placed in the redo log file:

```
ALTER DATABASE ADD SUPPLEMENTAL LOG DATA (ALL) COLUMNS;
```

However, if you enter the following SQL statement (specifying table-level supplemental logging) instead, then only when a column in the `employees` table is changed will the entire row (except for LOB, `LONG`s, and `ADT`s) of the table be placed in the redo log file. If a column changes in the `departments` table, only the changed column will be placed in the redo log file.

```
ALTER TABLE HR.EMPLOYEES ADD SUPPLEMENTAL LOG DATA (ALL) COLUMNS;
```

Keep the following in mind when you use table-level identification key logging:

- If the database is open when you enable identification key logging on a table, all DML cursors for that table in the cursor cache are invalidated. This can affect performance until the cursor cache is repopulated.
- Supplemental logging statements are cumulative. If you issue the following SQL statements, both primary key and unique index key table-level supplemental logging is enabled:

```
ALTER TABLE HR.EMPLOYEES ADD SUPPLEMENTAL LOG DATA (PRIMARY KEY) COLUMNS; ALTER TABLE HR.EMPLOYEES ADD SUPPLEMENTAL LOG DATA (UNIQUE) COLUMNS;
```

See Database-Level Identification Key Loggingfor a description of each of the identification key logging options.

Table-Level User-Defined Supplemental Log Groups

In addition to table-level identification key logging, Oracle supports user-defined supplemental log groups. With user-defined supplemental log groups, you can specify which columns are supplementally logged. You can specify conditional or unconditional log groups, as follows:

- User-defined unconditional log groups

  To enable supplemental logging that uses user-defined unconditional log groups, use the `ALWAYS` clause as shown in the following example:

  ```
  ALTER TABLE HR.EMPLOYEES ADD SUPPLEMENTAL LOG GROUP emp_parttime (EMPLOYEE_ID, LAST_NAME, DEPARTMENT_ID) ALWAYS;
  ```

  This creates a log group named `emp_parttime` on the `hr.employees` table that consists of the columns `employee_id`, `last_name`, and `department_id`. These columns will be logged every time an `UPDATE` statement is executed on the `hr.employees` table, regardless of whether or not the update affected these columns. (If you want to have the entire row image logged any time an update was made, use table-level `ALL` identification key logging, as described previously).

  Note:

  LOB, `LONG`, and `ADT` columns cannot be supplementally logged.

- User-defined conditional supplemental log groups

  To enable supplemental logging that uses user-defined conditional log groups, omit the `ALWAYS` clause from the SQL `ALTER TABLE` statement, as shown in the following example:

  ```
  ALTER TABLE HR.EMPLOYEES ADD SUPPLEMENTAL LOG GROUP emp_fulltime (EMPLOYEE_ID, LAST_NAME, DEPARTMENT_ID);
  ```

This creates a log group named `emp_fulltime` on table `hr.employees`. Just like the previous example, it consists of the columns `employee_id`, `last_name`, and `department_id`. But because the `ALWAYS` clause was omitted, before-images of the columns will be logged only if at least one of the columns is updated.

For both unconditional and conditional user-defined supplemental log groups, you can explicitly specify that a column in the log group be excluded from supplemental logging by specifying the `NO LOG` option. When you specify a log group and use the `NO LOG` option, you must specify at least one column in the log group without the `NOLOG` option, as shown in the following example:

```
ALTER TABLE HR.EMPLOYEES ADD SUPPLEMENTAL LOG GROUP emp_parttime( DEPARTMENT_ID NO LOG, EMPLOYEE_ID);
```

This enables you to associate this column with other columns in the named supplemental log group such that any modification to the `NO LOG` column causes the other columns in the supplemental log group to be placed in the redo log file. This might be useful, for example, if you want to log certain columns in a group if a `LONG`column changes. You cannot supplementally log the `LONG` column itself; however, you can use changes to that column to trigger supplemental logging of other columns in the same row.

Usage Notes for User-Defined Supplemental Log Groups

Keep the following in mind when you specify user-defined supplemental log groups:

- A column can belong to more than one supplemental log group. However, the before-image of the columns gets logged only once.
- If you specify the same columns to be logged both conditionally and unconditionally, the columns are logged unconditionally.

Tracking DDL Statements in the LogMiner Dictionary

LogMiner automatically builds its own internal dictionary from the LogMiner dictionary that you specify when you start LogMiner (either an online catalog, a dictionary in the redo log files, or a flat file). This dictionary provides a snapshot of the database objects and their definitions.

If your LogMiner dictionary is in the redo log files or is a flat file, you can use the `DDL_DICT_TRACKING` option to the PL/SQL `DBMS_LOGMNR.START_LOGMNR` procedure to direct LogMiner to track data definition language (DDL) statements. DDL tracking enables LogMiner to successfully track structural changes made to a database object, such as adding or dropping columns from a table. For example:

```
EXECUTE DBMS_LOGMNR.START_LOGMNR(OPTIONS => - DBMS_LOGMNR.DDL_DICT_TRACKING + DBMS_LOGMNR.DICT_FROM_REDO_LOGS);
```

See Example 5: Tracking DDL Statements in the Internal Dictionaryfor a complete example.

With this option set, LogMiner applies any DDL statements seen in the redo log files to its internal dictionary.

> **Note:**
> In general, it is a good idea to keep supplemental logging and the DDL tracking feature enabled, because if they are not enabled and a DDL event occurs, LogMiner returns some of the redo data as binary data. Also, a metadata version mismatch could occur.

When you enable `DDL_DICT_TRACKING`, data manipulation language (DML) operations performed on tables created after the LogMiner dictionary was extracted can be shown correctly.

For example, if a table `employees` is updated through two successive DDL operations such that column `gender` is added in one operation, and column `commission_pct` is dropped in the next, LogMiner will keep versioned information for `employees` for each of these changes. This means that LogMiner can successfully mine redo log files that are from before and after these DDL changes, and no binary data will be presented for the `SQL_REDO` or `SQL_UNDO` columns.

Because LogMiner automatically assigns versions to the database metadata, it will detect and notify you of any mismatch between its internal dictionary and the dictionary in the redo log files. If LogMiner detects a mismatch, it generates binary data in the `SQL_REDO` column of the `V$LOGMNR_CONTENTS` view, the `INFO` column contains the string "Dictionary Version Mismatch", and the `STATUS` column will contain the value `2`.

> **Note:**
> It is important to understand that the LogMiner internal dictionary is not the same as the LogMiner dictionary contained in a flat file, in redo log files, or in the online catalog. LogMiner does update its internal dictionary, but it does not update the dictionary that is contained in a flat file, in redo log files, or in the online catalog.

The following list describes the requirements for specifying the `DDL_DICT_TRACKING` option with the `DBMS_LOGMNR.START_LOGMNR` procedure.

- The `DDL_DICT_TRACKING` option is not valid with the `DICT_FROM_ONLINE_CATALOG` option.
- The `DDL_DICT_TRACKING` option requires that the database be open.
- Supplemental logging must be enabled database-wide, or log groups must have been created for the tables of interest.

DDL_DICT_TRACKING and Supplemental Logging Settings

Note the following interactions that occur when various settings of dictionary tracking and supplemental logging are combined:

- If `DDL_DICT_TRACKING` is enabled, but supplemental logging is not enabled and:
  - A DDL transaction is encountered in the redo log file, then a query of `V$LOGMNR_CONTENTS` will terminate with the ORA-01347 error.
  - A DML transaction is encountered in the redo log file, LogMiner will not assume that the current version of the table (underlying the DML) in its dictionary is correct, and columns in `V$LOGMNR_CONTENTS` will be set as follows:
    - The `SQL_REDO` column will contain binary data.
    - The `STATUS` column will contain a value of `2` (which indicates that the SQL is not valid).
    - The `INFO` column will contain the string 'Dictionary Mismatch'.
- If `DDL_DICT_TRACKING` is not enabled and supplemental logging is not enabled, and the columns referenced in a DML operation match the columns in the LogMiner dictionary, then LogMiner assumes that the latest version in its dictionary is correct, and columns in `V$LOGMNR_CONTENTS` will be set as follows:
  - LogMiner will use the definition of the object in its dictionary to generate values for the `SQL_REDO` and `SQL_UNDO` columns.
  - The status column will contain a value of `3` (which indicates that the SQL is not guaranteed to be accurate).
  - The `INFO` column will contain the string 'no supplemental log data found'.
- If `DDL_DICT_TRACKING` is not enabled and supplemental logging is not enabled and there are more modified columns in the redo log file for a table than the LogMiner dictionary definition for the table defines, then:
  - The `SQL_REDO` and `SQL_UNDO` columns will contain the string 'Dictionary Version Mismatch'.
  - The `STATUS` column will contain a value of `2` (which indicates that the SQL is not valid).
  - The `INFO` column will contain the string 'Dictionary Mismatch'.

Also be aware that it is possible to get unpredictable behavior if the dictionary definition of a column indicates one type but the column is really another type.

DDL_DICT_TRACKING and Specified Time or SCN Ranges

Because LogMiner must not miss a DDL statement if it is to ensure the consistency of its dictionary, LogMiner may start reading redo log files prior to your requested starting time or SCN (as specified with `DBMS_LOGMNR.START_LOGMNR`) when the `DDL_DICT_TRACKING` option is enabled. The actual time or SCN at which LogMiner starts reading redo log files is referred to as the **required starting time** or the **required starting SCN**.

No missing redo log files (based on sequence numbers) are allowed from the required starting time or the required starting SCN.

LogMiner determines where it will start reading redo log data as follows:

- After the dictionary is loaded, the first time that you call `DBMS_LOGMNR.START_LOGMNR`, LogMiner begins reading as determined by one of the following, whichever causes it to begin earlier:
  - Your requested starting time or SCN value
  - The commit SCN of the dictionary dump
- On subsequent calls to `DBMS_LOGMNR.START_LOGMNR`, LogMiner begins reading as determined for one of the following, whichever causes it to begin earliest:
  - Your requested starting time or SCN value
  - The start of the earliest DDL transaction where the `COMMIT` statement has not yet been read by LogMiner
  - The highest SCN read by LogMiner

The following scenario helps illustrate this:

Suppose you create a redo log file list containing five redo log files. Assume that a dictionary is contained in the first redo file, and the changes that you have indicated that you want to see (using `DBMS_LOGMNR.START_LOGMNR`) are recorded in the third redo log file. You then do the following:

1. Call `DBMS_LOGMNR.START_LOGMNR`. LogMiner will read:
   a. The first log file to load the dictionary

b. The second redo log file to pick up any possible DDLs contained within it

c. The third log file to retrieve the data of interest

2. Call `DBMS_LOGMNR.START_LOGMNR` again with the same requested range.

   LogMiner will begin with redo log file 3; it no longer needs to read redo log file 2, because it has already processed any DDL statements contained within it.

3. Call `DBMS_LOGMNR.START_LOGMNR` again, this time specifying parameters that require data to be read from redo log file 5.

   LogMiner will start reading from redo log file 4 to pick up any DDL statements that may be contained within it.

Query the `REQUIRED_START_DATE` or the `REQUIRED_START_SCN` columns of the `V$LOGMNR_PARAMETERS` view to see where LogMiner will actually start reading. Regardless of where LogMiner starts reading, only rows in your requested range will be returned from the `V$LOGMINER_CONTENTS` view.

Accessing LogMiner Operational Information in Views

LogMiner operational information (as opposed to redo data) is contained in the following views. You can use SQL to query them as you would any other view.

- `V$LOGMNR_DICTIONARY`

  Shows information about a LogMiner dictionary file that was created using the `STORE_IN_FLAT_FILE` option to `DBMS_LOGMNR.START_LOGMNR`. The information shown includes information about the database from which the LogMiner dictionary was created.

- `V$LOGMNR_LOGS`

  Shows information about specified redo log files, as described in Querying V$LOGMNR_LOGS.

- `V$LOGMNR_PARAMETERS`

  Shows information about optional LogMiner parameters, including starting and ending system change numbers (SCNs) and starting and ending times.

- `V$DATABASE`, `DBA_LOG_GROUPS`, `ALL_LOG_GROUPS`, `USER_LOG_GROUPS`, `DBA_LOG_GROUP_COLUMNS`, `ALL_LOG_GROUP_COLUMNS`, `USER_LOG_GROUP_COLUMNS`

Shows information about the current settings for supplemental logging, as described in Querying Views for Supplemental Logging Settings.

See Also:

Oracle Database Reference for detailed information about the contents of these views

Querying V$LOGMNR_LOGS

You can query the `V$LOGMNR_LOGS` view to determine which redo log files have been manually or automatically added to the list of redo log files for LogMiner to analyze. This view contains one row for each redo log file. It provides valuable information about each of the redo log files including filename, sequence #, SCN and time ranges, and whether it contains all or part of the LogMiner dictionary.

After a successful call to `DBMS_LOGMNR.START_LOGMNR`, the `STATUS` column of the `V$LOGMNR_LOGS` view contains one of the following values:

- `0`

  Indicates that the redo log file will be processed during a query of the `V$LOGMNR_CONTENTS` view.

- `1`

  Indicates that this will be the first redo log file to be processed by LogMiner during a select operation against the `V$LOGMNR_CONTENTS` view.

- `2`

  Indicates that the redo log file has been pruned and therefore will not be processed by LogMiner during a query of the `V$LOGMNR_CONTENTS` view. It has been pruned because it is not needed to satisfy your requested time or SCN range.

- `4`

  Indicates that a redo log file (based on sequence number) is missing from the LogMiner redo log file list.

The V$LOGMNR_LOGS view contains a row for each redo log file that is missing from the list, as follows:

- The FILENAME column will contain the consecutive range of sequence numbers and total SCN range gap.

  For example: 'Missing log file(s) for thread number 1, sequence number(s) 100 to 102'.

- The INFO column will contain the string 'MISSING_LOGFILE'.

Information about files missing from the redo log file list can be useful for the following reasons:

- The DDL_DICT_TRACKING and CONTINUOUS_MINE options that can be specified when you call DBMS_LOGMNR.START_LOGMNR will not allow redo log files to be missing from the LogMiner redo log file list for the requested time or SCN range. If a call to DBMS_LOGMNR.START_LOGMNR fails, you can query the STATUS column in the V$LOGMNR_LOGS view to determine which redo log files are missing from the list. You can then find and manually add these redo log files and attempt to call DBMS_LOGMNR.START_LOGMNR again.

- Although all other options that can be specified when you call DBMS_LOGMNR.START_LOGMNR allow files to be missing from the LogMiner redo log file list, you may not want to have missing files. You can query the V$LOGMNR_LOGS view before querying the V$LOGMNR_CONTENTS view to ensure that all required files are in the list. If the list is left with missing files and you query the V$LOGMNR_CONTENTS view, a row is returned in V$LOGMNR_CONTENTS with the following column values:

  - In the OPERATION column, a value of 'MISSING_SCN'

  - In the STATUS column, a value of 1291

  - In the INFO column, a string indicating the missing SCN range (for example, 'Missing SCN 100 - 200')

Querying Views for Supplemental Logging Settings

You can query a number of views to determine the current settings for supplemental logging, as described in the following list:

- V$DATABASE view

  - SUPPLEMENTAL_LOG_DATA_FK column

    This column contains one of the following values:

        - `NO` - if database-level identification key logging with the `FOREIGN KEY` option is not enabled
        - `YES` - if database-level identification key logging with the `FOREIGN KEY` option is enabled
    - `SUPPLEMENTAL_LOG_DATA_ALL` column

      This column contains one of the following values:

        - `NO` - if database-level identification key logging with the `ALL` option is not enabled
        - `YES` - if database-level identification key logging with the `ALL` option is enabled
    - `SUPPLEMENTAL_LOG_DATA_UI` column
        - `NO` - if database-level identification key logging with the `UNIQUE` option is not enabled
        - `YES` - if database-level identification key logging with the `UNIQUE` option is enabled
    - `SUPPLEMENTAL_LOG_DATA_MIN` column

      This column contains one of the following values:

        - `NO` - if no database-level supplemental logging is enabled
        - `IMPLICIT` - if minimal supplemental logging is enabled because database-level identification key logging options is enabled
        - `YES` - if minimal supplemental logging is enabled because the SQL `ALTER DATABASE ADD SUPPLEMENTAL LOG DATA` statement was issued
- `DBA_LOG_GROUPS`, `ALL_LOG_GROUPS`, and `USER_LOG_GROUPS` views
    - `ALWAYS` column

      This column contains one of the following values:

    - `ALWAYS` - indicates that the columns in this log group will be supplementally logged if any column in the associated row is updated
    - `CONDITIONAL` - indicates that the columns in this group will be supplementally logged only if a column in the log group is updated
  - `GENERATED` column

    This column contains one of the following values:

    - `GENERATED NAME` - if the LOG_GROUP name was system-generated
    - `USER NAME` - if the LOG_GROUP name was user-defined
  - `LOG_GROUP_TYPES` column

    This column contains one of the following values to indicate the type of logging defined for this log group. `USER LOG GROUP` indicates that the log group was user-defined (as opposed to system-generated).

    - ALL COLUMN LOGGING
    - FOREIGN KEY LOGGING
    - PRIMARY KEY LOGGING
    - UNIQUE KEY LOGGING
    - USER LOG GROUP
- `DBA_LOG_GROUP_COLUMNS`, `ALL_LOG_GROUP_COLUMNS`, and `USER_LOG_GROUP_COLUMNS` views
  - The `LOGGING_PROPERTY` column

    This column contains one of the following values:

    - `LOG` - indicates that this column in the log group will be supplementally logged
    - `NO LOG` - indicates that this column in the log group will not be supplementally logged

Steps in a Typical LogMiner Session

This section describes the steps in a typical LogMiner session. Each step is described in its own subsection.

1. Enable Supplemental Logging
2. Extract a LogMiner Dictionary(unless you plan to use the online catalog)
3. Specify Redo Log Files for Analysis
4. Start LogMiner
5. Query V$LOGMNR_CONTENTS
6. End the LogMiner Session

To run LogMiner, you use the `DBMS_LOGMNR` PL/SQL package. Additionally, you might also use the `DBMS_LOGMNR_D` package if you choose to extract a LogMiner dictionary rather than use the online catalog.

The `DBMS_LOGMNR` package contains the procedures used to initialize and run LogMiner, including interfaces to specify names of redo log files, filter criteria, and session characteristics. The `DBMS_LOGMNR_D` package queries the database dictionary tables of the current database to create a LogMiner dictionary file.

The LogMiner PL/SQL packages are owned by the `sys` schema. Therefore, if you are not connected as user `sys`:

- You must include `sys` in your call. For example:

```
EXECUTE SYS.DBMS_LOGMNR.END_LOGMNR;
```

- You must have been granted the `EXECUTE_CATALOG_ROLE` role.

See Also:

- *Oracle Database PL/SQL Packages and Types Reference* for details about syntax and parameters for these LogMiner packages
- *Oracle Database Application Developer's Guide - Fundamentals* for information about executing PL/SQL procedures

---

Enable Supplemental Logging

Enable the type of supplemental logging you want to use. At the very least, you must enable minimal supplemental logging, as follows:

```
ALTER DATABASE ADD SUPPLEMENTAL LOG DATA;
```

See Supplemental Logging for more information.

Extract a LogMiner Dictionary

To use LogMiner, you must supply it with a dictionary by doing one of the following:

- Specify use of the online catalog by using the `DICT_FROM_ONLINE_CATALOG` option when you start LogMiner. See Using the Online Catalog.
- Extract database dictionary information to the redo log files. See Extracting a LogMiner Dictionary to the Redo Log Files.
- Extract database dictionary information to a flat file. See Extracting the LogMiner Dictionary to a Flat File.

Specify Redo Log Files for Analysis

Before you can start LogMiner, you must specify the redo log files that you want to analyze. To do so, execute the `DBMS_LOGMNR.ADD_LOGFILE` procedure, as demonstrated in the following steps. You can add and remove redo log files in any order.

Note:

If you will be mining in the database instance that is generating the redo log files, you only need to specify the `CONTINUOUS_MINE`option and one of the following when you start LogMiner:

- The `STARTSCN` parameter
- The `STARTTIME` parameter

For more information, see Redo Log File Options.

---

1. Use SQL*Plus to start an Oracle instance, with the database either mounted or unmounted. For example, enter the `STARTUP` statement at the SQL prompt:

   ```
   STARTUP
   ```

2. Create a list of redo log files. Specify the `NEW` option of the `DBMS_LOGMNR.ADD_LOGFILE` PL/SQL procedure to signal that this is the beginning of a new list. For example, enter the following to specify the `/oracle/logs/log1.f` redo log file:

   ```
   EXECUTE DBMS_LOGMNR.ADD_LOGFILE( - LOGFILENAME => '/oracle/logs/log1.f', - OPTIONS => DBMS_LOGMNR.NEW);
   ```

3. If desired, add more redo log files by specifying the `ADDFILE` option of the `DBMS_LOGMNR.ADD_LOGFILE` PL/SQL procedure. For example, enter the following to add the `/oracle/logs/log2.f` redo log file:

   ```
   EXECUTE DBMS_LOGMNR.ADD_LOGFILE( - LOGFILENAME => '/oracle/logs/log2.f', - OPTIONS => DBMS_LOGMNR.ADDFILE);
   ```

   The `OPTIONS` parameter is optional when you are adding additional redo log files. For example, you could simply enter the following:

   ```
   EXECUTE DBMS_LOGMNR.ADD_LOGFILE( - LOGFILENAME=>'/oracle/logs/log2.f');
   ```

4. If desired, remove redo log files by using the `DBMS_LOGMNR.REMOVE_LOGFILE` PL/SQL procedure. For example, enter the following to remove the `/oracle/logs/log2.f` redo log file:

```
EXECUTE DBMS_LOGMNR.REMOVE_LOGFILE( - LOGFILENAME => '/oracle/logs/log2.f');
```

Start LogMiner

After you have created a LogMiner dictionary file and specified which redo log files to analyze, you must start LogMiner. Take the following steps:

1. Execute the `DBMS_LOGMNR.START_LOGMNR` procedure to start LogMiner.

   Oracle recommends that you specify a LogMiner dictionary option. If you do not, LogMiner cannot translate internal object identifiers and datatypes to object names and external data formats. Therefore, it would return internal object IDs and present data as binary data. Additionally, the `MINE_VALUE` and `COLUMN_PRESENT` functions cannot be used without a dictionary.

   If you are specifying the name of a flat file LogMiner dictionary, you must supply a fully qualified filename for the dictionary file. For example, to start LogMiner using `/oracle/database/dictionary.ora`, issue the following statement:

   ```
   EXECUTE DBMS_LOGMNR.START_LOGMNR( - DICTFILENAME =>'/oracle/database/dictionary.ora');
   ```

   If you are not specifying a flat file dictionary name, then use the `OPTIONS` parameter to specify either the `DICT_FROM_REDO_LOGS` or `DICT_FROM_ONLINE_CATALOG` option.

   If you specify `DICT_FROM_REDO_LOGS`, LogMiner expects to find a dictionary in the redo log files that you specified with the `DBMS_LOGMNR.ADD_LOGFILE`procedure. To determine which redo log files contain a dictionary, look at the `V$ARCHIVED_LOG` view. See Extracting a LogMiner Dictionary to the Redo Log Filesfor an example.

   Note:

   If you add additional redo log files after LogMiner has been started, you must restart LogMiner. LogMiner will not retain options that were included in the previous call to `DBMS_LOGMNR.START_LOGMNR`; you must respecify those options that you want to use. However, LogMiner will retain the dictionary specification from the previous call if you do not specify a dictionary in the current call to `DBMS_LOGMNR.START_LOGMNR`.

   For more information about the `DICT_FROM_ONLINE_CATALOG` option, see Using the Online Catalog.

2. Optionally, you can filter your query by time or by SCN. See Filtering Data by Timeor Filtering Data by SCN.

3. You can also use the `OPTIONS` parameter to specify additional characteristics of your LogMiner session. For example, you might decide to use the online catalog as your LogMiner dictionary and to have only committed transactions shown in the `V$LOGMNR_CONTENTS` view, as follows:

```
EXECUTE DBMS_LOGMNR.START_LOGMNR(OPTIONS => - DBMS_LOGMNR.DICT_FROM_ONLINE_CATALOG + - DBMS_LOGMNR.COMMITTED_DATA_ONLY);
```

   For more information about `DBMS_LOGMNR.START_LOGMNR` options, see *Oracle Database PL/SQL Packages and Types Reference*.

   You can execute the `DBMS_LOGMNR.START_LOGMNR` procedure multiple times, specifying different options each time. This can be useful, for example, if you did not get the desired results from a query of `V$LOGMNR_CONTENTS`, and want to restart LogMiner with different options. Unless you need to respecify the LogMiner dictionary, you do not need to add redo log files if they were already added with a previous call to `DBMS_LOGMNR.START_LOGMNR`.

Query V$LOGMNR_CONTENTS

At this point, LogMiner is started and you can perform queries against the `V$LOGMNR_CONTENTS` view. See Filtering and Formatting Data Returned to V$LOGMNR_CONTENTSfor examples of this.

End the LogMiner Session

To properly end a LogMiner session, use the `DBMS_LOGMNR.END_LOGMNR` PL/SQL procedure, as follows:

```
EXECUTE DBMS_LOGMNR.END_LOGMNR;
```

This procedure closes all the redo log files and allows all the database and system resources allocated by LogMiner to be released.

If this procedure is not executed, LogMiner retains all its allocated resources until the end of the Oracle session in which it was invoked. It is particularly important to use this procedure to end the LogMiner session if either the `DDL_DICT_TRACKING` option or the `DICT_FROM_REDO_LOGS` option was used.

Examples Using LogMiner

This section provides several examples of using LogMiner in each of the following general categories:

- Examples of Mining by Explicitly Specifying the Redo Log Files of Interest

- Examples of Mining Without Specifying the List of Redo Log Files Explicitly
- Example Scenarios

Note:

All examples in this section assume that minimal supplemental logging has been enabled:

```
SQL> ALTER DATABASE ADD SUPPLEMENTAL LOG DATA;
```

See Supplemental Loggingfor more information.

All examples, except Example 2: Mining the Redo Log Files in a Given SCN Rangeand the Example Scenarios, assume that the `NLS_DATE_FORMAT` parameter has been set as follows:

```
SQL> ALTER SESSION SET NLS_DATE_FORMAT = 'dd-mon-yyyy hh24:mi:ss';
```

Because LogMiner displays date data using the setting for the `NLS_DATE_FORMAT` parameter that is active for the user session, this step is optional. However, setting the parameter explicitly lets you predict the date format.

Examples of Mining by Explicitly Specifying the Redo Log Files of Interest

The following examples demonstrate how to use LogMiner when you know which redo log files contain the data of interest. This section contains the following list of examples; these examples are best read sequentially, because each example builds on the example or examples that precede it:

- Example 1: Finding All Modifications in the Last Archived Redo Log File
- Example 2: Grouping DML Statements into Committed Transactions
- Example 3: Formatting the Reconstructed SQL
- Example 4: Using the LogMiner Dictionary in the Redo Log Files

- Example 5: Tracking DDL Statements in the Internal Dictionary
- Example 6: Filtering Output by Time Range

The SQL output formatting may be different on your display than that shown in these examples.

Example 1: Finding All Modifications in the Last Archived Redo Log File

The easiest way to examine the modification history of a database is to mine at the source database and use the online catalog to translate the redo log files. This example shows how to do the simplest analysis using LogMiner.

This example finds all modifications that are contained in the last archived redo log generated by the database (assuming that the database is not an Oracle Real Application Clusters database).

Step 1 Determine which redo log file was most recently archived.

This example assumes that you know that you want to mine the redo log file that was most recently archived.

```
SELECT NAME FROM V$ARCHIVED_LOG WHERE FIRST_TIME = (SELECT MAX(FIRST_TIME) FROM V$ARCHIVED_LOG); NAME ----------------------------
--------------- /usr/oracle/data/db1arch_1_16_482701534.dbf
```

Step 2 Specify the list of redo log files to be analyzed.

Specify the redo log file that was returned by the query in Step 1. The list will consist of one redo log file.

```
EXECUTE DBMS_LOGMNR.ADD_LOGFILE( - LOGFILENAME => '/usr/oracle/data/db1arch_1_16_482701534.dbf', - OPTIONS => DBMS_LOGMNR.NEW);
```

Step 3 Start LogMiner.

Start LogMiner and specify the dictionary to use.

```
EXECUTE DBMS_LOGMNR.START_LOGMNR( - OPTIONS => DBMS_LOGMNR.DICT_FROM_ONLINE_CATALOG);
```

Step 4 Query the V$LOGMNR_CONTENTS view.

Note that there are four transactions (two of them were committed within the redo log file being analyzed, and two were not). The output shows the DML statements in the order in which they were executed; thus transactions interleave among themselves.

```
SELECT username AS USR, (XIDUSN || '.' || XIDSLT || '.' || XIDSQN) AS XID, SQL_REDO, SQL_UNDO FROM V$LOGMNR_CONTENTS WHERE
username IN ('HR', 'OE'); USR XID SQL_REDO SQL_UNDO ---- --------- ----------------------------------------------------- HR
1.11.1476 set transaction read write; HR 1.11.1476 insert into "HR"."EMPLOYEES"( delete from "HR"."EMPLOYEES"
"EMPLOYEE_ID","FIRST_NAME", where "EMPLOYEE_ID" = '306' "LAST_NAME","EMAIL", and "FIRST_NAME" = 'Nandini'
"PHONE_NUMBER","HIRE_DATE", and "LAST_NAME" = 'Shastry' "JOB_ID","SALARY", and "EMAIL" = 'NSHASTRY' "COMMISSION_PCT","MANAGER_ID",
and "PHONE_NUMBER" = '1234567890' "DEPARTMENT_ID") values and "HIRE_DATE" = TO_DATE('10-JAN-2003 ('306','Nandini','Shastry',
13:34:43', 'dd-mon-yyyy hh24:mi:ss') 'NSHASTRY', '1234567890', and "JOB_ID" = 'HR_REP' and TO_DATE('10-jan-2003 13:34:43',
"SALARY" = '120000' and 'dd-mon-yyyy hh24:mi:ss'), "COMMISSION_PCT" = '.05' and 'HR_REP','120000', '.05', "DEPARTMENT_ID" = '10'
and '105','10'); ROWID = 'AAAHSkAABAAAY6rAAO'; OE 1.1.1484 set transaction read write; OE 1.1.1484 update
"OE"."PRODUCT_INFORMATION" update "OE"."PRODUCT_INFORMATION" set "WARRANTY_PERIOD" = set "WARRANTY_PERIOD" = TO_YMINTERVAL('+05-
00') where TO_YMINTERVAL('+01-00') where "PRODUCT_ID" = '1799' and "PRODUCT_ID" = '1799' and "WARRANTY_PERIOD" = "WARRANTY_PERIOD"
= TO_YMINTERVAL('+01-00') and TO_YMINTERVAL('+05-00') and ROWID = 'AAAHTKAABAAAY9mAAB'; ROWID = 'AAAHTKAABAAAY9mAAB'; OE 1.1.1484
update "OE"."PRODUCT_INFORMATION" update "OE"."PRODUCT_INFORMATION" set "WARRANTY_PERIOD" = set "WARRANTY_PERIOD" =
TO_YMINTERVAL('+05-00') where TO_YMINTERVAL('+01-00') where "PRODUCT_ID" = '1801' and "PRODUCT_ID" = '1801' and "WARRANTY_PERIOD"
= "WARRANTY_PERIOD" = TO_YMINTERVAL('+01-00') and TO_YMINTERVAL('+05-00') and ROWID = 'AAAHTKAABAAAY9mAAC'; ROWID
='AAAHTKAABAAAY9mAAC'; HR 1.11.1476 insert into "HR"."EMPLOYEES"( delete from "HR"."EMPLOYEES" "EMPLOYEE_ID","FIRST_NAME",
"EMPLOYEE_ID" = '307' and "LAST_NAME","EMAIL", "FIRST_NAME" = 'John' and "PHONE_NUMBER","HIRE_DATE", "LAST_NAME" = 'Silver' and
"JOB_ID","SALARY", "EMAIL" = 'JSILVER' and "COMMISSION_PCT","MANAGER_ID", "PHONE_NUMBER" = '5551112222' "DEPARTMENT_ID") values
and "HIRE_DATE" = TO_DATE('10-jan-2003 ('307','John','Silver', 13:41:03', 'dd-mon-yyyy hh24:mi:ss') 'JSILVER', '5551112222', and
"JOB_ID" ='105' and "DEPARTMENT_ID" TO_DATE('10-jan-2003 13:41:03', = '50' and ROWID = 'AAAHSkAABAAAY6rAAP'; 'dd-mon-yyyy
hh24:mi:ss'), 'SH_CLERK','110000', '.05', '105','50'); OE 1.1.1484 commit; HR 1.15.1481 set transaction read write; HR 1.15.1481
delete from "HR"."EMPLOYEES" insert into "HR"."EMPLOYEES"( where "EMPLOYEE_ID" = '205' and "EMPLOYEE_ID","FIRST_NAME",
"FIRST_NAME" = 'Shelley' and "LAST_NAME","EMAIL","PHONE_NUMBER", "LAST_NAME" = 'Higgins' and "HIRE_DATE", "JOB_ID","SALARY",
"EMAIL" = 'SHIGGINS' and "COMMISSION_PCT","MANAGER_ID", "PHONE_NUMBER" = '515.123.8080' "DEPARTMENT_ID") values and "HIRE_DATE" =
TO_DATE( ('205','Shelley','Higgins', '07-jun-1994 10:05:01', and 'SHIGGINS','515.123.8080', 'dd-mon-yyyy hh24:mi:ss') TO_DATE('07-
jun-1994 10:05:01', and "JOB_ID" = 'AC_MGR' 'dd-mon-yyyy hh24:mi:ss'), and "SALARY"= '12000' 'AC_MGR','12000',NULL,'101','110');
and "COMMISSION_PCT" IS NULL and "MANAGER_ID" = '101' and "DEPARTMENT_ID" = '110' and ROWID = 'AAAHSkAABAAAY6rAAM'; OE 1.8.1484
set transaction read write; OE 1.8.1484 update "OE"."PRODUCT_INFORMATION" update "OE"."PRODUCT_INFORMATION" set "WARRANTY_PERIOD"
= set "WARRANTY_PERIOD" = TO_YMINTERVAL('+12-06') where TO_YMINTERVAL('+20-00') where "PRODUCT_ID" = '2350' and "PRODUCT_ID" =
'2350' and "WARRANTY_PERIOD" = "WARRANTY_PERIOD" = TO_YMINTERVAL('+20-00') and TO_YMINTERVAL('+20-00') and ROWID =
'AAAHTKAABAAAY9tAAD'; ROWID ='AAAHTKAABAAAY9tAAD'; HR 1.11.1476 commit;
```

Step 5 End the LogMiner session.

```
SQL> EXECUTE DBMS_LOGMNR.END_LOGMNR();
```

Example 2: Grouping DML Statements into Committed Transactions

As shown in the first example, Example 1: Finding All Modifications in the Last Archived Redo Log File, LogMiner displays all modifications it finds in the redo log files that it analyzes by default, regardless of whether the transaction has been committed or not. In addition, LogMiner shows modifications in the same order in which they were executed. Because DML statements that belong to the same transaction are not grouped together, visual inspection of the output can be difficult. Although you can use SQL to group transactions, LogMiner provides an easier way. In this example, the latest archived redo log file will again be analyzed, but it will return only committed transactions.

Step 1 Determine which redo log file was most recently archived by the database.

This example assumes that you know that you want to mine the redo log file that was most recently archived.

```
SELECT NAME FROM V$ARCHIVED_LOG WHERE FIRST_TIME = (SELECT MAX(FIRST_TIME) FROM V$ARCHIVED_LOG); NAME ----------------------------
--------------- /usr/oracle/data/db1arch_1_16_482701534.dbf
```

Step 2 Specify the list of redo log files to be analyzed.

Specify the redo log file that was returned by the query in Step 1. The list will consist of one redo log file.

```
EXECUTE DBMS_LOGMNR.ADD_LOGFILE( - LOGFILENAME => '/usr/oracle/data/db1arch_1_16_482701534.dbf', - OPTIONS => DBMS_LOGMNR.NEW);
```

Step 3 Start LogMiner.

Start LogMiner by specifying the dictionary to use and the `COMMITTED_DATA_ONLY` option.

```
EXECUTE DBMS_LOGMNR.START_LOGMNR( - OPTIONS => DBMS_LOGMNR.DICT_FROM_ONLINE_CATALOG + - DBMS_LOGMNR.COMMITTED_DATA_ONLY);
```

Step 4 Query the V$LOGMNR_CONTENTS view.

Although transaction 1.11.1476 was started before transaction 1.1.1484 (as revealed in Example 1: Finding All Modifications in the Last Archived Redo Log File), it committed after transaction 1.1.1484 committed. In this example, therefore, transaction 1.1.1484 is shown in its entirety before transaction 1.11.1476. The two transactions that did not commit within the redo log file being analyzed are not returned.

```
SELECT username AS USR, (XIDUSN || '.' || XIDSLT || '.' || XIDSQN) AS XID, SQL_REDO, SQL_UNDO FROM V$LOGMNR_CONTENTS WHERE
username IN ('HR', 'OE'); ; USR XID SQL_REDO SQL_UNDO ---- --------- ------------------------------ ------------------------------
---- OE 1.1.1484 set transaction read write; OE 1.1.1484 update "OE"."PRODUCT_INFORMATION" update "OE"."PRODUCT_INFORMATION" set
"WARRANTY_PERIOD" = set "WARRANTY_PERIOD" = TO_YMINTERVAL('+05-00') where TO_YMINTERVAL('+01-00') where "PRODUCT_ID" = '1799' and
"PRODUCT_ID" = '1799' and "WARRANTY_PERIOD" = "WARRANTY_PERIOD" = TO_YMINTERVAL('+01-00') and TO_YMINTERVAL('+05-00') and ROWID =
'AAAHTKAABAAAY9mAAB'; ROWID = 'AAAHTKAABAAAY9mAAB'; OE 1.1.1484 update "OE"."PRODUCT_INFORMATION" update
"OE"."PRODUCT_INFORMATION" set "WARRANTY_PERIOD" = set "WARRANTY_PERIOD" = TO_YMINTERVAL('+05-00') where TO_YMINTERVAL('+01-00')
where "PRODUCT_ID" = '1801' and "PRODUCT_ID" = '1801' and "WARRANTY_PERIOD" = "WARRANTY_PERIOD" = TO_YMINTERVAL('+01-00') and
TO_YMINTERVAL('+05-00') and ROWID = 'AAAHTKAABAAAY9mAAC'; ROWID ='AAAHTKAABAAAY9mAAC'; OE 1.1.1484 commit; HR 1.11.1476 set
transaction read write; HR 1.11.1476 insert into "HR"."EMPLOYEES"( delete from "HR"."EMPLOYEES" "EMPLOYEE_ID","FIRST_NAME", where
"EMPLOYEE_ID" = '306' "LAST_NAME","EMAIL", and "FIRST_NAME" = 'Nandini' "PHONE_NUMBER","HIRE_DATE", and "LAST_NAME" = 'Shastry'
"JOB_ID","SALARY", and "EMAIL" = 'NSHASTRY' "COMMISSION_PCT","MANAGER_ID", and "PHONE_NUMBER" = '1234567890' "DEPARTMENT_ID")
values and "HIRE_DATE" = TO_DATE('10-JAN-2003 ('306','Nandini','Shastry', 13:34:43', 'dd-mon-yyyy hh24:mi:ss') 'NSHASTRY',
'1234567890', and "JOB_ID" = 'HR_REP' and TO_DATE('10-jan-2003 13:34:43', "SALARY" = '120000' and 'dd-mon-yyy hh24:mi:ss'),
"COMMISSION_PCT" = '.05' and 'HR_REP','120000', '.05', "DEPARTMENT_ID" = '10' and '105','10'); ROWID = 'AAAHSkAABAAAY6rAAO'; HR
1.11.1476 insert into "HR"."EMPLOYEES"( delete from "HR"."EMPLOYEES" "EMPLOYEE_ID","FIRST_NAME", "EMPLOYEE_ID" = '307' and
"LAST_NAME","EMAIL", "FIRST_NAME" = 'John' and "PHONE_NUMBER","HIRE_DATE", "LAST_NAME" = 'Silver' and "JOB_ID","SALARY", "EMAIL" =
'JSILVER' and "COMMISSION_PCT","MANAGER_ID", "PHONE_NUMBER" = '5551112222' "DEPARTMENT_ID") values and "HIRE_DATE" = TO_DATE('10-
jan-2003 ('307','John','Silver', 13:41:03', 'dd-mon-yyyy hh24:mi:ss') 'JSILVER', '5551112222', and "JOB_ID" ='105' and
"DEPARTMENT_ID" TO_DATE('10-jan-2003 13:41:03', = '50' and ROWID = 'AAAHSkAABAAAY6rAAP'; 'dd-mon-yyyy hh24:mi:ss'),
'SH_CLERK','110000', '.05', '105','50'); HR 1.11.1476 commit;
```

Step 5 End the LogMiner session.

```
EXECUTE DBMS_LOGMNR.END_LOGMNR();
```

Example 3: Formatting the Reconstructed SQL

As shown in Example 2: Grouping DML Statements into Committed Transactions, using the `COMMITTED_DATA_ONLY` option with the dictionary in the online redo log file is an easy way to focus on committed transactions. However, one aspect remains that makes visual inspection difficult: the association between the column names and their respective values in an `INSERT` statement are not apparent. This can be addressed by specifying the `PRINT_PRETTY_SQL` option. Note that specifying this option will make some of the reconstructed SQL statements nonexecutable.

Step 1 Determine which redo log file was most recently archived.

This example assumes that you know that you want to mine the redo log file that was most recently archived.

```
SELECT NAME FROM V$ARCHIVED_LOG WHERE FIRST_TIME = (SELECT MAX(FIRST_TIME) FROM V$ARCHIVED_LOG); NAME ----------------------------
--------------- /usr/oracle/data/db1arch_1_16_482701534.dbf
```

Step 2 Specify the list of redo log files to be analyzed.

Specify the redo log file that was returned by the query in Step 1. The list will consist of one redo log file.

```
EXECUTE DBMS_LOGMNR.ADD_LOGFILE( - LOGFILENAME => '/usr/oracle/data/db1arch_1_16_482701534.dbf', - OPTIONS => DBMS_LOGMNR.NEW);
```

Step 3 Start LogMiner.

Start LogMiner by specifying the dictionary to use and the `COMMITTED_DATA_ONLY` and `PRINT_PRETTY_SQL` options.

```
EXECUTE DBMS_LOGMNR.START_LOGMNR(- OPTIONS => DBMS_LOGMNR.DICT_FROM_ONLINE_CATALOG + - DBMS_LOGMNR.COMMITTED_DATA_ONLY + -
DBMS_LOGMNR.PRINT_PRETTY_SQL);
```

The `DBMS_LOGMNR.PRINT_PRETTY_SQL` option changes only the format of the reconstructed SQL, and therefore is useful for generating reports for visual inspection.

Step 4 Query the V$LOGMNR_CONTENTS view for SQL_REDO statements.

```
SELECT username AS USR, (XIDUSN || '.' || XIDSLT || '.' || XIDSQN) AS XID, SQL_REDO FROM V$LOGMNR_CONTENTS; USR XID SQL_REDO ----
--------- ---------------------------------------------------- OE 1.1.1484 set transaction read write; OE 1.1.1484 update
"OE"."PRODUCT_INFORMATION" set "WARRANTY_PERIOD" = TO_YMINTERVAL('+05-00') where "PRODUCT_ID" = '1799' and "WARRANTY_PERIOD" =
TO_YMINTERVAL('+01-00') and ROWID = 'AAAHTKAABAAAY9mAAB'; OE 1.1.1484 update "OE"."PRODUCT_INFORMATION" set "WARRANTY_PERIOD" =
TO_YMINTERVAL('+05-00') where "PRODUCT_ID" = '1801' and "WARRANTY_PERIOD" = TO_YMINTERVAL('+01-00') and ROWID =
'AAAHTKAABAAAY9mAAC'; OE 1.1.1484 commit; HR 1.11.1476 set transaction read write; HR 1.11.1476 insert into "HR"."EMPLOYEES"
values "EMPLOYEE_ID" = 306, "FIRST_NAME" = 'Nandini', "LAST_NAME" = 'Shastry', "EMAIL" = 'NSHASTRY', "PHONE_NUMBER" =
'1234567890', "HIRE_DATE" = TO_DATE('10-jan-2003 13:34:43', 'dd-mon-yyyy hh24:mi:ss', "JOB_ID" = 'HR_REP', "SALARY" = 120000,
"COMMISSION_PCT" = .05, "MANAGER_ID" = 105, "DEPARTMENT_ID" = 10; HR 1.11.1476 insert into "HR"."EMPLOYEES" values "EMPLOYEE_ID" =
307, "FIRST_NAME" = 'John', "LAST_NAME" = 'Silver', "EMAIL" = 'JSILVER', "PHONE_NUMBER" = '5551112222', "HIRE_DATE" = TO_DATE('10-
jan-2003 13:41:03', 'dd-mon-yyyy hh24:mi:ss'), "JOB_ID" = 'SH_CLERK', "SALARY" = 110000, "COMMISSION_PCT" = .05, "MANAGER_ID" =
105, "DEPARTMENT_ID" = 50; HR 1.11.1476 commit;
```

Step 5 Query the V$LOGMNR_CONTENTS view for reconstructed SQL_UNDO statements.

```
SELECT username AS USR, (XIDUSN || '.' || XIDSLT || '.' || XIDSQN) AS XID, SQL_UNDO FROM V$LOGMNR_CONTENTS; USR XID SQL_UNDO ----
--------- ---------------------------------------------------- OE 1.1.1484 set transaction read write; OE 1.1.1484 update
"OE"."PRODUCT_INFORMATION" set "WARRANTY_PERIOD" = TO_YMINTERVAL('+01-00') where "PRODUCT_ID" = '1799' and "WARRANTY_PERIOD" =
TO_YMINTERVAL('+05-00') and ROWID = 'AAAHTKAABAAAY9mAAB'; OE 1.1.1484 update "OE"."PRODUCT_INFORMATION" set "WARRANTY_PERIOD" =
TO_YMINTERVAL('+01-00') where "PRODUCT_ID" = '1801' and "WARRANTY_PERIOD" = TO_YMINTERVAL('+05-00') and ROWID =
'AAAHTKAABAAAY9mAAC'; OE 1.1.1484 commit; HR 1.11.1476 set transaction read write; HR 1.11.1476 delete from "HR"."EMPLOYEES" where
"EMPLOYEE_ID" = 306 and "FIRST_NAME" = 'Nandini' and "LAST_NAME" = 'Shastry' and "EMAIL" = 'NSHASTRY' and "PHONE_NUMBER" =
'1234567890' and "HIRE_DATE" = TO_DATE('10-jan-2003 13:34:43', 'dd-mon-yyyy hh24:mi:ss') and "JOB_ID" = 'HR_REP' and "SALARY" =
120000 and "COMMISSION_PCT" = .05 and "MANAGER_ID" = 105 and "DEPARTMENT_ID" = 10 and ROWID = 'AAAHSkAABAAAY6rAAO'; HR 1.11.1476
delete from "HR"."EMPLOYEES" where "EMPLOYEE_ID" = 307 and "FIRST_NAME" = 'John' and "LAST_NAME" = 'Silver' and "EMAIL" =
'JSILVER' and "PHONE_NUMBER" = '555122122' and "HIRE_DATE" = TO_DATE('10-jan-2003 13:41:03', 'dd-mon-yyyy hh24:mi:ss') and
"JOB_ID" = 'SH_CLERK' and "SALARY" = 110000 and "COMMISSION_PCT" = .05 and "MANAGER_ID" = 105 and "DEPARTMENT_ID" = 50 and ROWID =
'AAAHSkAABAAAY6rAAP'; HR 1.11.1476 commit;
```

Step 6 End the LogMiner session.

```
EXECUTE DBMS_LOGMNR.END_LOGMNR();
```

Example 4: Using the LogMiner Dictionary in the Redo Log Files

This example shows how to use the dictionary that has been extracted to the redo log files. When you use the dictionary in the online catalog, you must mine the redo log files in the same database that generated them. Using the dictionary contained in the redo log files enables you to mine redo log files in a different database.

Step 1 Determine which redo log file was most recently archived by the database.

This example assumes that you know that you want to mine the redo log file that was most recently archived.

```
SELECT NAME, SEQUENCE# FROM V$ARCHIVED_LOG WHERE FIRST_TIME = (SELECT MAX(FIRST_TIME) FROM V$ARCHIVED_LOG); NAME SEQUENCE# -------
---------------------------------- -------------- /usr/oracle/data/db1arch_1_210_482701534.dbf 210
```

Step 2 Find the redo log files containing the dictionary.

The dictionary may be contained in more than one redo log file. Therefore, you need to determine which redo log files contain the start and end of the dictionary. Query the `V$ARCHIVED_LOG` view, as follows:

1. Find a redo log file that contains the end of the dictionary extract. This redo log file must have been created before the redo log file that you want to analyze, but should be as recent as possible.

   ```
   SELECT NAME, SEQUENCE#, DICTIONARY_BEGIN d_beg, DICTIONARY_END d_end FROM V$ARCHIVED_LOG WHERE SEQUENCE# = (SELECT MAX
   (SEQUENCE#) FROM V$ARCHIVED_LOG WHERE DICTIONARY_END = 'YES' and SEQUENCE# <= 210); NAME SEQUENCE# D_BEG D_END ------------
   ------------------------------ ---------- ----- ------ /usr/oracle/data/db1arch_1_208_482701534.dbf 208 NO YES
   ```

2. Find the redo log file that contains the start of the data dictionary extract that matches the end of the dictionary found in the previous step:

   ```
   SELECT NAME, SEQUENCE#, DICTIONARY_BEGIN d_beg, DICTIONARY_END d_end FROM V$ARCHIVED_LOG WHERE SEQUENCE# = (SELECT MAX
   (SEQUENCE#) FROM V$ARCHIVED_LOG WHERE DICTIONARY_BEGIN = 'YES' and SEQUENCE# <= 208); NAME SEQUENCE# D_BEG D_END -----------
   ------------------------------ ---------- ----- ------ /usr/oracle/data/db1arch_1_207_482701534.dbf 207 YES NO
   ```

3. Specify the list of the redo log files of interest. Add the redo log files that contain the start and end of the dictionary and the redo log file that you want to analyze. You can add the redo log files in any order.

   ```
   EXECUTE DBMS_LOGMNR.ADD_LOGFILE(- LOGFILENAME => '/usr/oracle/data/db1arch_1_210_482701534.dbf', - OPTIONS =>
   DBMS_LOGMNR.NEW); EXECUTE DBMS_LOGMNR.ADD_LOGFILE(- LOGFILENAME => '/usr/oracle/data/db1arch_1_208_482701534.dbf'); EXECUTE
   DBMS_LOGMNR.ADD_LOGFILE(- LOGFILENAME => '/usr/oracle/data/db1arch_1_207_482701534.dbf');
   ```

4. Query the `V$LOGMNR_LOGS` view to display the list of redo log files to be analyzed, including their timestamps.

   In the output, LogMiner flags a missing redo log file. LogMiner lets you proceed with mining, provided that you do not specify an option that requires the missing redo log file for proper functioning.

```
SQL> SELECT FILENAME AS name, LOW_TIME, HIGH_TIME FROM V$LOGMNR_LOGS; NAME LOW_TIME HIGH_TIME ----------------------------------
- -------------------- -------------------- /usr/data/db1arch_1_207_482701534.dbf 10-jan-2003 12:01:34 10-jan-2003 13:32:46
/usr/data/db1arch_1_208_482701534.dbf 10-jan-2003 13:32:46 10-jan-2003 15:57:03 Missing logfile(s) for thread number 1, 10-jan-
2003 15:57:03 10-jan-2003 15:59:53 sequence number(s) 209 to 209 /usr/data/db1arch_1_210_482701534.dbf 10-jan-2003 15:59:53 10-
jan-2003 16:07:41
```

Step 3 Start LogMiner.

Start LogMiner by specifying the dictionary to use and the `COMMITTED_DATA_ONLY` and `PRINT_PRETTY_SQL` options.

```
EXECUTE DBMS_LOGMNR.START_LOGMNR(- OPTIONS => DBMS_LOGMNR.DICT_FROM_REDO_LOGS + - DBMS_LOGMNR.COMMITTED_DATA_ONLY + -
DBMS_LOGMNR.PRINT_PRETTY_SQL);
```

Step 4 Query the V$LOGMNR_CONTENTS view.

To reduce the number of rows returned by the query, exclude from the query all DML statements done in the `sys` or `system` schemas. (This query specifies a timestamp to exclude transactions that were involved in the dictionary extraction.)

The output shows three transactions: two DDL transactions and one DML transaction. The DDL transactions, 1.2.1594 and 1.18.1602, create the table `oe.product_tracking` and create a trigger on table `oe.product_information`, respectively. In both transactions, the DML statements done to the system tables (tables owned by `sys`) are filtered out because of the query predicate.

The DML transaction, 1.9.1598, updates the `oe.product_information` table. The update operation in this transaction is fully translated. However, the query output also contains some untranslated reconstructed SQL statements. Most likely, these statements were done on the `oe.product_tracking` table that was created after the data dictionary was extracted to the redo log files.

(The next example shows how to run LogMiner with the `DDL_DICT_TRACKING` option so that all SQL statements are fully translated; no binary data is returned.)

```
SELECT USERNAME AS usr, SQL_REDO FROM V$LOGMNR_CONTENTS WHERE SEG_OWNER IS NULL OR SEG_OWNER NOT IN ('SYS', 'SYSTEM') AND
TIMESTAMP > '10-jan-2003 15:59:53'; USR XID SQL_REDO --- -------- ---------------------------------- SYS 1.2.1594 set transaction
read write; SYS 1.2.1594 create table oe.product_tracking (product_id number not null, modified_time date, old_list_price
number(8,2), old_warranty_period interval year(2) to month); SYS 1.2.1594 commit; SYS 1.18.1602 set transaction read write; SYS
1.18.1602 create or replace trigger oe.product_tracking_trigger before update on oe.product_information for each row when
(new.list_price <> old.list_price or new.warranty_period <> old.warranty_period) declare begin insert into oe.product_tracking
values (:old.product_id, sysdate, :old.list_price, :old.warranty_period); end; SYS 1.18.1602 commit; OE 1.9.1598 update
"OE"."PRODUCT_INFORMATION" set "WARRANTY_PERIOD" = TO_YMINTERVAL('+08-00'), "LIST_PRICE" = 100 where "PRODUCT_ID" = 1729 and
"WARRANTY_PERIOD" = TO_YMINTERVAL('+05-00') and "LIST_PRICE" = 80 and ROWID = 'AAAHTKAABAAAY9yAAA'; OE 1.9.1598 insert into
"UNKNOWN"."OBJ# 33415" values "COL 1" = HEXTORAW('c2121e'), "COL 2" = HEXTORAW('7867010d110804'), "COL 3" = HEXTORAW('c151'), "COL
4" = HEXTORAW('800000053c'); OE 1.9.1598 update "OE"."PRODUCT_INFORMATION" set "WARRANTY_PERIOD" = TO_YMINTERVAL('+08-00'),
"LIST_PRICE" = 92 where "PRODUCT_ID" = 2340 and "WARRANTY_PERIOD" = TO_YMINTERVAL('+05-00') and "LIST_PRICE" = 72 and ROWID =
'AAAHTKAABAAAY9zAAA'; OE 1.9.1598 insert into "UNKNOWN"."OBJ# 33415" values "COL 1" = HEXTORAW('c21829'), "COL 2" =
HEXTORAW('7867010d110808'), "COL 3" = HEXTORAW('c149'), "COL 4" = HEXTORAW('800000053c'); OE 1.9.1598 commit;
```

Step 5 Issue additional queries, if desired.

Display all the DML statements that were executed as part of the `CREATE TABLE` DDL statement. This includes statements executed by users and internally by Oracle.

Note:

If you choose to reapply statements displayed by a query such as the one shown here, reapply DDL statements only. Do not reapply DML statements that were executed internally by Oracle, or you risk corrupting your database. In the following output, the only statement that you should use in a reapply operation is the `CREATE TABLE OE.PRODUCT_TRACKING` statement.

SELECT SQL_REDO FROM V$LOGMNR_CONTENTS WHERE XIDUSN = 1 and XIDSLT = 2 and XIDSQN = 1594; SQL_REDO ------------------------------
-- set transaction read write; insert into "SYS"."OBJ$" values "OBJ#" = 33415,
"DATAOBJ#" = 33415, "OWNER#" = 37, "NAME" = 'PRODUCT_TRACKING', "NAMESPACE" = 1, "SUBNAME" IS NULL, "TYPE#" = 2, "CTIME" =
TO_DATE('13-jan-2003 14:01:03', 'dd-mon-yyyy hh24:mi:ss'), "MTIME" = TO_DATE('13-jan-2003 14:01:03', 'dd-mon-yyyy hh24:mi:ss'),
"STIME" = TO_DATE('13-jan-2003 14:01:03', 'dd-mon-yyyy hh24:mi:ss'), "STATUS" = 1, "REMOTEOWNER" IS NULL, "LINKNAME" IS NULL,
"FLAGS" = 0, "OID$" IS NULL, "SPARE1" = 6, "SPARE2" = 1, "SPARE3" IS NULL, "SPARE4" IS NULL, "SPARE5" IS NULL, "SPARE6" IS NULL;
insert into "SYS"."TAB$" values "OBJ#" = 33415, "DATAOBJ#" = 33415, "TS#" = 0, "FILE#" = 1, "BLOCK#" = 121034, "BOBJ#" IS NULL,
"TAB#" IS NULL, "COLS" = 5, "CLUCOLS" IS NULL, "PCTFREE$" = 10, "PCTUSED$" = 40, "INITRANS" = 1, "MAXTRANS" = 255, "FLAGS" = 1,
"AUDIT$" = '--------------------------------------', "ROWCNT" IS NULL, "BLKCNT" IS NULL, "EMPCNT" IS NULL, "AVGSPC" IS NULL,
"CHNCNT" IS NULL, "AVGRLN" IS NULL, "AVGSPC_FLB" IS NULL, "FLBCNT" IS NULL, "ANALYZETIME" IS NULL, "SAMPLESIZE" IS NULL, "DEGREE"
IS NULL, "INSTANCES" IS NULL, "INTCOLS" = 5, "KERNELCOLS" = 5, "PROPERTY" = 536870912, "TRIGFLAG" = 0, "SPARE1" = 178, "SPARE2" IS
NULL, "SPARE3" IS NULL, "SPARE4" IS NULL, "SPARE5" IS NULL, "SPARE6" = TO_DATE('13-jan-2003 14:01:05', 'dd-mon-yyyy hh24:mi:ss'),
insert into "SYS"."COL$" values "OBJ#" = 33415, "COL#" = 1, "SEGCOL#" = 1, "SEGCOLLENGTH" = 22, "OFFSET" = 0, "NAME" =
'PRODUCT_ID', "TYPE#" = 2, "LENGTH" = 22, "FIXEDSTORAGE" = 0, "PRECISION#" IS NULL, "SCALE" IS NULL, "NULL$" = 1, "DEFLENGTH" IS
NULL, "SPARE6" IS NULL, "INTCOL#" = 1, "PROPERTY" = 0, "CHARSETID" = 0, "CHARSETFORM" = 0, "SPARE1" = 0, "SPARE2" = 0, "SPARE3" =
0, "SPARE4" IS NULL, "SPARE5" IS NULL, "DEFAULT$" IS NULL; insert into "SYS"."COL$" values "OBJ#" = 33415, "COL#" = 2, "SEGCOL#" =
2, "SEGCOLLENGTH" = 7, "OFFSET" = 0, "NAME" = 'MODIFIED_TIME', "TYPE#" = 12, "LENGTH" = 7, "FIXEDSTORAGE" = 0, "PRECISION#" IS
NULL, "SCALE" IS NULL, "NULL$" = 0, "DEFLENGTH" IS NULL, "SPARE6" IS NULL, "INTCOL#" = 2, "PROPERTY" = 0, "CHARSETID" = 0,
"CHARSETFORM" = 0, "SPARE1" = 0, "SPARE2" = 0, "SPARE3" = 0, "SPARE4" IS NULL, "SPARE5" IS NULL, "DEFAULT$" IS NULL; insert into
"SYS"."COL$" values "OBJ#" = 33415, "COL#" = 3, "SEGCOL#" = 3, "SEGCOLLENGTH" = 22, "OFFSET" = 0, "NAME" = 'OLD_LIST_PRICE',
"TYPE#" = 2, "LENGTH" = 22, "FIXEDSTORAGE" = 0, "PRECISION#" = 8, "SCALE" = 2, "NULL$" = 0, "DEFLENGTH" IS NULL, "SPARE6" IS NULL,
"INTCOL#" = 3, "PROPERTY" = 0, "CHARSETID" = 0, "CHARSETFORM" = 0, "SPARE1" = 0, "SPARE2" = 0, "SPARE3" = 0, "SPARE4" IS NULL,
"SPARE5" IS NULL, "DEFAULT$" IS NULL; insert into "SYS"."COL$" values "OBJ#" = 33415, "COL#" = 4, "SEGCOL#" = 4, "SEGCOLLENGTH" =
5, "OFFSET" = 0, "NAME" = 'OLD_WARRANTY_PERIOD', "TYPE#" = 182, "LENGTH" = 5, "FIXEDSTORAGE" = 0, "PRECISION#" = 2, "SCALE" = 0,
"NULL$" = 0, "DEFLENGTH" IS NULL, "SPARE6" IS NULL, "INTCOL#" = 4, "PROPERTY" = 0, "CHARSETID" = 0, "CHARSETFORM" = 0, "SPARE1" =
0, "SPARE2" = 2, "SPARE3" = 0, "SPARE4" IS NULL, "SPARE5" IS NULL, "DEFAULT$" IS NULL; insert into "SYS"."CCOL$" values "OBJ#" =
33415, "CON#" = 2090, "COL#" = 1, "POS#" IS NULL, "INTCOL#" = 1, "SPARE1" = 0, "SPARE2" IS NULL, "SPARE3" IS NULL, "SPARE4" IS
NULL, "SPARE5" IS NULL, "SPARE6" IS NULL; insert into "SYS"."CDEF$" values "OBJ#" = 33415, "CON#" = 2090, "COLS" = 1, "TYPE#" = 7,
"ROBJ#" IS NULL, "RCON#" IS NULL, "RRULES" IS NULL, "MATCH#" IS NULL, "REFACT" IS NULL, "ENABLED" = 1, "CONDLENGTH" = 24, "SPARE6"
IS NULL, "INTCOLS" = 1, "MTIME" = TO_DATE('13-jan-2003 14:01:08', 'dd-mon-yyyy hh24:mi:ss'), "DEFER" = 12, "SPARE1" = 6, "SPARE2"
IS NULL, "SPARE3" IS NULL, "SPARE4" IS NULL, "SPARE5" IS NULL, "CONDITION" = '"PRODUCT_ID" IS NOT NULL'; create table
oe.product_tracking (product_id number not null, modified_time date, old_product_description varchar2(2000), old_list_price
number(8,2), old_warranty_period interval year(2) to month); update "SYS"."SEG$" set "TYPE#" = 5, "BLOCKS" = 5, "EXTENTS" = 1,
"INIEXTS" = 5, "MINEXTS" = 1, "MAXEXTS" = 121, "EXTSIZE" = 5, "EXTPCT" = 50, "USER#" = 37, "LISTS" = 0, "GROUPS" = 0, "CACHEHINT"
= 0, "HWMINCR" = 33415, "SPARE1" = 1024 where "TS#" = 0 and "FILE#" = 1 and "BLOCK#" = 121034 and "TYPE#" = 3 and "BLOCKS" = 5 and

```
"EXTENTS" = 1 and "INIEXTS" = 5 and "MINEXTS" = 1 and "MAXEXTS" = 121 and "EXTSIZE" = 5 and "EXTPCT" = 50 and "USER#" = 37 and
"LISTS" = 0 and "GROUPS" = 0 and "BITMAPRANGES" = 0 and "CACHEHINT" = 0 and "SCANHINT" = 0 and "HWMINCR" = 33415 and "SPARE1" =
1024 and "SPARE2" IS NULL and ROWID = 'AAAAAIAABAAAdMOAAB'; insert into "SYS"."CON$" values "OWNER#" = 37, "NAME" = 'SYS_C002090',
"CON#" = 2090, "SPARE1" IS NULL, "SPARE2" IS NULL, "SPARE3" IS NULL, "SPARE4" IS NULL, "SPARE5" IS NULL, "SPARE6" IS NULL; commit;
```

Step 6 End the LogMiner session.

```
EXECUTE DBMS_LOGMNR.END_LOGMNR();
```

Example 5: Tracking DDL Statements in the Internal Dictionary

By using the `DBMS_LOGMNR.DDL_DICT_TRACKING` option, this example ensures that the LogMiner internal dictionary is updated with the DDL statements encountered in the redo log files.

Step 1 Determine which redo log file was most recently archived by the database.

This example assumes that you know that you want to mine the redo log file that was most recently archived.

```
SELECT NAME, SEQUENCE# FROM V$ARCHIVED_LOG WHERE FIRST_TIME = (SELECT MAX(FIRST_TIME) FROM V$ARCHIVED_LOG); NAME SEQUENCE# -------
---------------------------------- -------------- /usr/oracle/data/db1arch_1_210_482701534.dbf 210
```

Step 2 Find the dictionary in the redo log files.

Because the dictionary may be contained in more than one redo log file, you need to determine which redo log files contain the start and end of the data dictionary. Query the `V$ARCHIVED_LOG` view, as follows:

1. Find a redo log that contains the end of the data dictionary extract. This redo log file must have been created before the redo log files that you want to analyze, but should be as recent as possible.

   ```
   SELECT NAME, SEQUENCE#, DICTIONARY_BEGIN d_beg, DICTIONARY_END d_end FROM V$ARCHIVED_LOG WHERE SEQUENCE# = (SELECT MAX
   (SEQUENCE#) FROM V$ARCHIVED_LOG WHERE DICTIONARY_END = 'YES' and SEQUENCE# < 210); NAME SEQUENCE# D_BEG D_END --------------
   ---------------------------- ---------- ----- ------ /usr/oracle/data/db1arch_1_208_482701534.dbf 208 NO YES
   ```

2. Find the redo log file that contains the start of the data dictionary extract that matches the end of the dictionary found by the previous SQL statement:

```
SELECT NAME, SEQUENCE#, DICTIONARY_BEGIN d_beg, DICTIONARY_END d_end FROM V$ARCHIVED_LOG WHERE SEQUENCE# = (SELECT MAX
(SEQUENCE#) FROM V$ARCHIVED_LOG WHERE DICTIONARY_BEGIN = 'YES' and SEQUENCE# <= 208); NAME SEQUENCE# D_BEG D_END ----------
------------------------------- ---------- ----- ------ /usr/oracle/data/db1arch_1_208_482701534.dbf 207 YES NO
```

Step 3 Make sure you have a complete list of redo log files.

To successfully apply DDL statements encountered in the redo log files, ensure that all files are included in the list of redo log files to mine. The missing log file corresponding to sequence# 209 must be included in the list. Determine the names of the redo log files that you need to add to the list by issuing the following query:

```
SELECT NAME FROM V$ARCHIVED_LOG WHERE SEQUENCE# >= 207 AND SEQUENCE# <= 210 ORDER BY SEQUENCE# ASC; NAME ----------
------------------- /usr/oracle/data/db1arch_1_207_482701534.dbf /usr/oracle/data/db1arch_1_208_482701534.dbf
/usr/oracle/data/db1arch_1_209_482701534.dbf /usr/oracle/data/db1arch_1_210_482701534.dbf
```

Step 4 Specify the list of the redo log files of interest.

Include the redo log files that contain the beginning and end of the dictionary, the redo log file that you want to mine, and any redo log files required to create a list without gaps. You can add the redo log files in any order.

```
EXECUTE DBMS_LOGMNR.ADD_LOGFILE(- LOGFILENAME => '/usr/oracle/data/db1arch_1_210_482701534.dbf', -

OPTIONS => DBMS_LOGMNR.NEW);

EXECUTE DBMS_LOGMNR.ADD_LOGFILE(- LOGFILENAME => '/usr/oracle/data/db1arch_1_209_482701534.dbf'); EXECUTE
DBMS_LOGMNR.ADD_LOGFILE(- LOGFILENAME => '/usr/oracle/data/db1arch_1_208_482701534.dbf'); EXECUTE DBMS_LOGMNR.ADD_LOGFILE(-
LOGFILENAME => '/usr/oracle/data/db1arch_1_207_482701534.dbf');
```

Step 5 Start LogMiner.

Start LogMiner by specifying the dictionary to use and the `DDL_DICT_TRACKING`, `COMMITTED_DATA_ONLY`, and `PRINT_PRETTY_SQL` options.

```
EXECUTE DBMS_LOGMNR.START_LOGMNR(- OPTIONS => DBMS_LOGMNR.DICT_FROM_REDO_LOGS + - DBMS_LOGMNR.DDL_DICT_TRACKING + -
DBMS_LOGMNR.COMMITTED_DATA_ONLY + - DBMS_LOGMNR.PRINT_PRETTY_SQL);
```

Step 6 Query the V$LOGMNR_CONTENTS view.

To reduce the number of rows returned, exclude from the query all DML statements done in the `sys` or `system` schemas. (This query specifies a timestamp to exclude transactions that were involved in the dictionary extraction.)

The query returns all the reconstructed SQL statements correctly translated and the insert operations on the `oe.product_tracking` table that occurred because of the trigger execution.

```
SELECT USERNAME AS usr,(XIDUSN || '.' || XIDSLT || '.' || XIDSQN) as XID, SQL_REDO FROM V$LOGMNR_CONTENTS WHERE SEG_OWNER IS NULL
OR SEG_OWNER NOT IN ('SYS', 'SYSTEM') AND TIMESTAMP > '10-jan-2003 15:59:53'; USR XID SQL_REDO ----------- -------- --------------
--------------------- SYS 1.2.1594 set transaction read write; SYS 1.2.1594 create table oe.product_tracking (product_id number
not null, modified_time date, old_list_price number(8,2), old_warranty_period interval year(2) to month); SYS 1.2.1594 commit; SYS
1.18.1602 set transaction read write; SYS 1.18.1602 create or replace trigger oe.product_tracking_trigger before update on
oe.product_information for each row when (new.list_price <> old.list_price or new.warranty_period <> old.warranty_period) declare
begin insert into oe.product_tracking values (:old.product_id, sysdate, :old.list_price, :old.warranty_period); end; SYS 1.18.1602
commit; OE 1.9.1598 update "OE"."PRODUCT_INFORMATION" set "WARRANTY_PERIOD" = TO_YMINTERVAL('+08-00'), "LIST_PRICE" = 100 where
"PRODUCT_ID" = 1729 and "WARRANTY_PERIOD" = TO_YMINTERVAL('+05-00') and "LIST_PRICE" = 80 and ROWID = 'AAAHTKAABAAAY9yAAA'; OE
1.9.1598 insert into "OE"."PRODUCT_TRACKING" values "PRODUCT_ID" = 1729, "MODIFIED_TIME" = TO_DATE('13-jan-2003 16:07:03', 'dd-
mon-yyyy hh24:mi:ss'), "OLD_LIST_PRICE" = 80, "OLD_WARRANTY_PERIOD" = TO_YMINTERVAL('+05-00'); OE 1.9.1598 update
"OE"."PRODUCT_INFORMATION" set "WARRANTY_PERIOD" = TO_YMINTERVAL('+08-00'), "LIST_PRICE" = 92 where "PRODUCT_ID" = 2340 and
"WARRANTY_PERIOD" = TO_YMINTERVAL('+05-00') and "LIST_PRICE" = 72 and ROWID = 'AAAHTKAABAAAY9zAAA'; OE 1.9.1598 insert into
"OE"."PRODUCT_TRACKING" values "PRODUCT_ID" = 2340, "MODIFIED_TIME" = TO_DATE('13-jan-2003 16:07:07', 'dd-mon-yyyy hh24:mi:ss'),
"OLD_LIST_PRICE" = 72, "OLD_WARRANTY_PERIOD" = TO_YMINTERVAL('+05-00'); OE 1.9.1598 commit;
```

Step 7 End the LogMiner session.

```
EXECUTE DBMS_LOGMNR.END_LOGMNR();
```

Example 6: Filtering Output by Time Range

In the previous two examples, rows were filtered by specifying a timestamp-based predicate (timestamp > '10-jan-2003 15:59:53') in the query. However, a more efficient way to filter out redo records based on timestamp values is by specifying the time range in the `DBMS_LOGMNR.START_LOGMNR` procedure call, as shown in this example.

Step 1 Create a list of redo log files to mine.

Suppose you want to mine redo log files generated since a given time. The following procedure creates a list of redo log files based on a specified time. The subsequent SQL `EXECUTE` statement calls the procedure and specifies the starting time as 2 p.m. on Jan-13-2003.

```
-- -- my_add_logfiles -- Add all archived logs generated after a specified start_time. -- CREATE OR REPLACE PROCEDURE
my_add_logfiles (in_start_time IN DATE) AS CURSOR c_log IS SELECT NAME FROM V$ARCHIVED_LOG WHERE FIRST_TIME >= in_start_time;
count pls_integer := 0; my_option pls_integer := DBMS_LOGMNR.NEW; BEGIN FOR c_log_rec IN c_log LOOP
DBMS_LOGMNR.ADD_LOGFILE(LOGFILENAME => c_log_rec.name, OPTIONS => my_option); my_option := DBMS_LOGMNR.ADDFILE;
DBMS_OUTPUT.PUT_LINE('Added logfile ' || c_log_rec.name); END LOOP; END; / EXECUTE my_add_logfiles(in_start_time => '13-jan-2003
14:00:00');
```

Step 2 Query the V$LOGMNR_LOGS to see the list of redo log files.

This example includes the size of the redo log files in the output.

```
SELECT FILENAME name, LOW_TIME start_time, FILESIZE bytes FROM V$LOGMNR_LOGS; NAME START_TIME BYTES ------------------------------
----- -------------------- ---------------- /usr/orcl/arch1_310_482932022.dbf 13-jan-2003 14:02:35 23683584
/usr/orcl/arch1_311_482932022.dbf 13-jan-2003 14:56:35 2564096 /usr/orcl/arch1_312_482932022.dbf 13-jan-2003 15:10:43 23683584
/usr/orcl/arch1_313_482932022.dbf 13-jan-2003 15:17:52 23683584 /usr/orcl/arch1_314_482932022.dbf 13-jan-2003 15:23:10 23683584
/usr/orcl/arch1_315_482932022.dbf 13-jan-2003 15:43:22 23683584 /usr/orcl/arch1_316_482932022.dbf 13-jan-2003 16:03:10 23683584
/usr/orcl/arch1_317_482932022.dbf 13-jan-2003 16:33:43 23683584 /usr/orcl/arch1_318_482932022.dbf 13-jan-2003 17:23:10 23683584
```

Step 3 Adjust the list of redo log files.

Suppose you realize that you want to mine just the redo log files generated between 3 p.m. and 4 p.m.

You could use the query predicate (`timestamp > '13-jan-2003 15:00:00' and timestamp < '13-jan-2003 16:00:00'`) to accomplish this. However, the query predicate is evaluated on each row returned by LogMiner, and the internal mining engine does not filter rows based on the query predicate. Thus, although you only wanted to get rows out of redo log files `arch1_311_482932022.dbf` to `arch1_315_482932022.dbf`, your query would result in mining all redo log files registered to the LogMiner session.

Furthermore, although you could use the query predicate and manually remove the redo log files that do not fall inside the time range of interest, the simplest solution is to specify the time range of interest in the `DBMS_LOGMNR.START_LOGMNR` procedure call.

Although this does not change the list of redo log files, LogMiner will mine only those redo log files that fall in the time range specified.

```
EXECUTE DBMS_LOGMNR.START_LOGMNR(- STARTTIME => '13-jan-2003 15:00:00', - ENDTIME => '13-jan-2003 16:00:00', - OPTIONS =>
DBMS_LOGMNR.DICT_FROM_ONLINE_CATALOG + - DBMS_LOGMNR.COMMITTED_DATA_ONLY + - DBMS_LOGMNR.PRINT_PRETTY_SQL);
```

Step 4 Query the V$LOGMNR_CONTENTS view.

```
SELECT TIMESTAMP, (XIDUSN || '.' || XIDSLT || '.' || XIDSQN) AS XID,

SQL_REDO FROM V$LOGMNR_CONTENTS WHERE SEG_OWNER = 'OE'; TIMESTAMP XID SQL_REDO -------------------- ----------- -----------------
--------------- 13-jan-2003 15:29:31 1.17.2376 update "OE"."PRODUCT_INFORMATION" set "WARRANTY_PERIOD" = TO_YMINTERVAL('+05-00')
where "PRODUCT_ID" = 3399 and "WARRANTY_PERIOD" = TO_YMINTERVAL('+02-00') and ROWID = 'AAAHTKAABAAAY9TAAE'; 13-jan-2003 15:29:34
1.17.2376 insert into "OE"."PRODUCT_TRACKING" values "PRODUCT_ID" = 3399, "MODIFIED_TIME" = TO_DATE('13-jan-2003 15:29:34', 'dd-
mon-yyyy hh24:mi:ss'), "OLD_LIST_PRICE" = 815, "OLD_WARRANTY_PERIOD" = TO_YMINTERVAL('+02-00'); 13-jan-2003 15:52:43 1.15.1756
update "OE"."PRODUCT_INFORMATION" set "WARRANTY_PERIOD" = TO_YMINTERVAL('+05-00') where "PRODUCT_ID" = 1768 and "WARRANTY_PERIOD"
= TO_YMINTERVAL('+02-00') and ROWID = 'AAAHTKAABAAAY9UAAB'; 13-jan-2003 15:52:43 1.15.1756 insert into "OE"."PRODUCT_TRACKING"
values "PRODUCT_ID" = 1768, "MODIFIED_TIME" = TO_DATE('13-jan-2003 16:52:43', 'dd-mon-yyyy hh24:mi:ss'), "OLD_LIST_PRICE" = 715,
"OLD_WARRANTY_PERIOD" = TO_YMINTERVAL('+02-00');
```

Step 5 End the LogMiner session.

```
EXECUTE DBMS_LOGMNR.END_LOGMNR();
```

Examples of Mining Without Specifying the List of Redo Log Files Explicitly

The previous set of examples explicitly specified the redo log file or files to be mined. However, if you are mining in the same database that generated the redo log files, then you can mine the appropriate list of redo log files by just specifying the time (or SCN) range of interest. To mine a set of redo log files without explicitly specifying them, use the `DBMS_LOGMNR.CONTINUOUS_MINE` option to the `DBMS_LOGMNR.START_LOGMNR` procedure, and specify either a time range or an SCN range of interest.

This section contains the following list of examples; these examples are best read in sequential order, because each example builds on the example or examples that precede it:

- Example 1: Mining Redo Log Files in a Given Time Range
- Example 2: Mining the Redo Log Files in a Given SCN Range
- Example 3: Using Continuous Mining to Include Future Values in a Query

The SQL output formatting may be different on your display than that shown in these examples.

Example 1: Mining Redo Log Files in a Given Time Range

This example is similar to Example 4: Using the LogMiner Dictionary in the Redo Log Files, except the list of redo log files are not specified explicitly. This example assumes that you want to use the data dictionary extracted to the redo log files.

Step 1 Determine the timestamp of the redo log file that contains the start of the data dictionary.

```
SELECT NAME, FIRST_TIME FROM V$ARCHIVED_LOG

WHERE SEQUENCE# = (SELECT MAX(SEQUENCE#) FROM V$ARCHIVED_LOG WHERE DICTIONARY_BEGIN = 'YES'); NAME FIRST_TIME --------------------
---------------------- -------------------- /usr/oracle/data/db1arch_1_207_482701534.dbf 10-jan-2003 12:01:34
```

Step 2 Display all the redo log files that have been generated so far.

This step is not required, but is included to demonstrate that the `CONTINUOUS_MINE` option works as expected, as will be shown in Step 4.

```
SELECT FILENAME name FROM V$LOGMNR_LOGS WHERE LOW_TIME > '10-jan-2003 12:01:34'; NAME ----------------------------------------
-- /usr/oracle/data/db1arch_1_207_482701534.dbf /usr/oracle/data/db1arch_1_208_482701534.dbf
/usr/oracle/data/db1arch_1_209_482701534.dbf /usr/oracle/data/db1arch_1_210_482701534.dbf
```

Step 3 Start LogMiner.

Start LogMiner by specifying the dictionary to use and the `COMMITTED_DATA_ONLY`, `PRINT_PRETTY_SQL`, and `CONTINUOUS_MINE` options.

```
EXECUTE DBMS_LOGMNR.START_LOGMNR(- STARTTIME => '10-jan-2003 12:01:34', - ENDTIME => SYSDATE, - OPTIONS =>
DBMS_LOGMNR.DICT_FROM_REDO_LOGS + - DBMS_LOGMNR.COMMITTED_DATA_ONLY + - DBMS_LOGMNR.PRINT_PRETTY_SQL + -
DBMS_LOGMNR.CONTINUOUS_MINE);
```

Step 4 Query the V$LOGMNR_LOGS view.

This step shows that the `DBMS_LOGMNR.START_LOGMNR` procedure with the `CONTINUOUS_MINE` option includes all of the redo log files that have been generated so far, as expected. (Compare the output in this step to the output in Step 2.)

```
SELECT FILENAME name FROM V$LOGMNR_LOGS; NAME ----------------------------------------------------
/usr/oracle/data/db1arch_1_207_482701534.dbf /usr/oracle/data/db1arch_1_208_482701534.dbf
/usr/oracle/data/db1arch_1_209_482701534.dbf /usr/oracle/data/db1arch_1_210_482701534.dbf
```

Step 5 Query the V$LOGMNR_CONTENTS view.

To reduce the number of rows returned by the query, exclude all DML statements done in the `sys` or `system` schema. (This query specifies a timestamp to exclude transactions that were involved in the dictionary extraction.)

Note that all reconstructed SQL statements returned by the query are correctly translated.

```
SELECT USERNAME AS usr,(XIDUSN || '.' || XIDSLT || '.' || XIDSQN) as XID, SQL_REDO FROM V$LOGMNR_CONTENTS WHERE SEG_OWNER IS NULL
OR SEG_OWNER NOT IN ('SYS', 'SYSTEM') AND TIMESTAMP > '10-jan-2003 15:59:53'; USR XID SQL_REDO ----------- -------- --------------
-------------------- SYS 1.2.1594 set transaction read write; SYS 1.2.1594 create table oe.product_tracking (product_id number
not null, modified_time date, old_list_price number(8,2), old_warranty_period interval year(2) to month); SYS 1.2.1594 commit; SYS
1.18.1602 set transaction read write; SYS 1.18.1602 create or replace trigger oe.product_tracking_trigger before update on
oe.product_information for each row when (new.list_price <> old.list_price or new.warranty_period <> old.warranty_period) declare
begin insert into oe.product_tracking values (:old.product_id, sysdate, :old.list_price, :old.warranty_period); end; SYS 1.18.1602
commit; OE 1.9.1598 update "OE"."PRODUCT_INFORMATION" set "WARRANTY_PERIOD" = TO_YMINTERVAL('+08-00'), "LIST_PRICE" = 100 where
"PRODUCT_ID" = 1729 and "WARRANTY_PERIOD" = TO_YMINTERVAL('+05-00') and "LIST_PRICE" = 80 and ROWID = 'AAAHTKAABAAAY9yAAA'; OE
1.9.1598 insert into "OE"."PRODUCT_TRACKING" values "PRODUCT_ID" = 1729, "MODIFIED_TIME" = TO_DATE('13-jan-2003 16:07:03', 'dd-
mon-yyyy hh24:mi:ss'), "OLD_LIST_PRICE" = 80, "OLD_WARRANTY_PERIOD" = TO_YMINTERVAL('+05-00'); OE 1.9.1598 update
"OE"."PRODUCT_INFORMATION" set "WARRANTY_PERIOD" = TO_YMINTERVAL('+08-00'), "LIST_PRICE" = 92 where "PRODUCT_ID" = 2340 and
"WARRANTY_PERIOD" = TO_YMINTERVAL('+05-00') and "LIST_PRICE" = 72 and ROWID = 'AAAHTKAABAAAY9zAAA'; OE 1.9.1598 insert into
"OE"."PRODUCT_TRACKING" values "PRODUCT_ID" = 2340, "MODIFIED_TIME" = TO_DATE('13-jan-2003 16:07:07', 'dd-mon-yyyy hh24:mi:ss'),
"OLD_LIST_PRICE" = 72, "OLD_WARRANTY_PERIOD" = TO_YMINTERVAL('+05-00'); OE 1.9.1598 commit;
```

Step 6 End the LogMiner session.

```
EXECUTE DBMS_LOGMNR.END_LOGMNR();
```

Example 2: Mining the Redo Log Files in a Given SCN Range

This example shows how to specify an SCN range of interest and mine the redo log files that satisfy that range. You can use LogMiner to see all committed DML statements whose effects have not yet been made permanent in the datafiles.

Note that in this example (unlike the other examples) it is not assumed that you have set the `NLS_DATE_FORMAT` parameter.

Step 1 Determine the SCN of the last checkpoint taken.

```
SELECT CHECKPOINT_CHANGE#, CURRENT_SCN FROM V$DATABASE;

CHECKPOINT_CHANGE# CURRENT_SCN ------------------ --------------- 56453576 56454208
```

Step 2 Start LogMiner and specify the CONTINUOUS_MINE option.

```
EXECUTE DBMS_LOGMNR.START_LOGMNR(-

STARTSCN => 56453576, - ENDSCN => 56454208, - OPTIONS => DBMS_LOGMNR.DICT_FROM_ONLINE_CATALOG + - DBMS_LOGMNR.COMMITTED_DATA_ONLY
+ - DBMS_LOGMNR.PRINT_PRETTY_SQL + - DBMS_LOGMNR.CONTINUOUS_MINE);
```

Step 3 Display the list of archived redo log files added by LogMiner.

```
SELECT FILENAME name, LOW_SCN, NEXT_SCN FROM V$LOGMNR_LOGS;

NAME LOW_SCN NEXT_SCN ------------------------------------------ -------- -------- /usr/oracle/data/db1arch_1_215_482701534.dbf
56316771 56453579
```

Note that the redo log file that LogMiner added does not contain the whole SCN range. When you specify the `CONTINUOUS_MINE` option, LogMiner adds only archived redo log files when you call the `DBMS_LOGMNR.START_LOGMNR` procedure. LogMiner will add the rest of the SCN range contained in the online redo log files automatically, as needed during the query execution. Use the following query to determine whether the redo log file added is the latest archived redo log file produced.

```
SELECT NAME FROM V$ARCHIVED_LOG WHERE SEQUENCE# = (SELECT MAX(SEQUENCE#) FROM V$ARCHIVED_LOG); NAME ----------------------------
-------------- /usr/oracle/data/db1arch_1_215_482701534.dbf
```

Step 4 Query the V$LOGMNR_CONTENTS view for changes made to the user tables.

The following query does not return the `SET TRANSACTION READ WRITE` and `COMMIT` statements associated with transaction 1.6.1911 because these statements do not have a segment owner (`SEG_OWNER`) associated with them.

Note that the default NLS_DATE_FORMAT, 'DD-MON-RR', is used to display the column MODIFIED_TIME of type DATE.

```
SELECT SCN, (XIDUSN || '.' || XIDSLT || '.' || XIDSQN) as XID, SQL_REDO FROM V$LOGMNR_CONTENTS WHERE SEG_OWNER NOT IN ('SYS',
'SYSTEM'); SCN XID SQL_REDO ---------- ---------- ------------- 56454198 1.6.1911 update "OE"."PRODUCT_INFORMATION" set
"WARRANTY_PERIOD" = TO_YMINTERVAL('+05-00') where "PRODUCT_ID" = 2430 and "WARRANTY_PERIOD" = TO_YMINTERVAL('+02-00') and ROWID =
'AAAHTKAABAAAY9AAAC'; 56454199 1.6.1911 insert into "OE"."PRODUCT_TRACKING" values "PRODUCT_ID" = 2430, "MODIFIED_TIME" =
TO_DATE('17-JAN-03', 'DD-MON-RR'), "OLD_LIST_PRICE" = 175, "OLD_WARRANTY_PERIOD" = TO_YMINTERVAL('+02-00'); 56454204 1.6.1911
update "OE"."PRODUCT_INFORMATION" set "WARRANTY_PERIOD" = TO_YMINTERVAL('+05-00') where "PRODUCT_ID" = 2302 and "WARRANTY_PERIOD"
= TO_YMINTERVAL('+02-00') and ROWID = 'AAAHTKAABAAAY9QAAA'; 56454206 1.6.1911 insert into "OE"."PRODUCT_TRACKING" values
"PRODUCT_ID" = 2302, "MODIFIED_TIME" = TO_DATE('17-JAN-03', 'DD-MON-RR'), "OLD_LIST_PRICE" = 150, "OLD_WARRANTY_PERIOD" =
TO_YMINTERVAL('+02-00');
```

Step 5 End the LogMiner session.

```
EXECUTE DBMS_LOGMNR.END_LOGMNR();
```

Example 3: Using Continuous Mining to Include Future Values in a Query

To specify that a query not finish until some future time occurs or SCN is reached, use the CONTINUOUS_MINE option and set either the ENDTIME or ENDSCAN option in your call to the DBMS_LOGMNR.START_LOGMNR procedure to a time in the future or to an SCN value that has not yet been reached.

This examples assumes that you want to monitor all changes made to the table hr.employees from now until 5 hours from now, and that you are using the dictionary in the online catalog.

Step 1 Start LogMiner.

```
EXECUTE DBMS_LOGMNR.START_LOGMNR(-

STARTTIME => SYSDATE, - ENDTIME => SYSDATE + 5/24, - OPTIONS => DBMS_LOGMNR.CONTINUOUS_MINE + -
DBMS_LOGMNR.DICT_FROM_ONLINE_CATALOG);
```

Step 2 Query the V$LOGMNR_CONTENTS view.

This select operation will not complete until it encounters the first redo log file record that is generated after the time range of interest (5 hours from now). You can end the select operation prematurely by entering Ctrl+C.

This example specifies the `SET ARRAYSIZE` statement so that rows are displayed as they are entered in the redo log file. If you do not specify the `SET ARRAYSIZE`statement, rows are not returned until the SQL internal buffer is full.

```
SET ARRAYSIZE 1; SELECT USERNAME AS usr, SQL_REDO FROM V$LOGMNR_CONTENTS WHERE SEG_OWNER = 'HR' AND TABLE_NAME = 'EMPLOYEES';
```

Step 3 End the LogMiner session.

```
EXECUTE DBMS_LOGMNR.END_LOGMNR();
```

Example Scenarios

The examples in this section demonstrate how to use LogMiner for typical scenarios. This section includes the following examples:

- Scenario 1: Using LogMiner to Track Changes Made by a Specific User
- Scenario 2: Using LogMiner to Calculate Table Access Statistics

Scenario 1: Using LogMiner to Track Changes Made by a Specific User

This example shows how to see all changes made to the database in a specific time range by a single user: `joedevo`. Connect to the database and then take the following steps:

1. Create the LogMiner dictionary file.

   To use LogMiner to analyze `joedevo`'s data, you must either create a LogMiner dictionary file before any table definition changes are made to tables that `joedevo` uses or use the online catalog at LogMiner startup. See Extract a LogMiner Dictionaryfor examples of creating LogMiner dictionaries. This example uses a LogMiner dictionary that has been extracted to the redo log files.

2. Add redo log files.

   Assume that `joedevo` has made some changes to the database. You can now specify the names of the redo log files that you want to analyze, as follows:

```
EXECUTE DBMS_LOGMNR.ADD_LOGFILE( - LOGFILENAME => 'log1orc1.ora', - OPTIONS => DBMS_LOGMNR.NEW);
```

If desired, add additional redo log files, as follows:

```
EXECUTE DBMS_LOGMNR.ADD_LOGFILE( - LOGFILENAME => 'log2orc1.ora', - OPTIONS => DBMS_LOGMNR.ADDFILE);
```

3. Start LogMiner and limit the search to the specified time range:

```
EXECUTE DBMS_LOGMNR.START_LOGMNR( - DICTFILENAME => 'orcldict.ora', - STARTTIME => TO_DATE('01-Jan-1998 08:30:00','DD-MON-YYYY HH:MI:SS'), - ENDTIME => TO_DATE('01-Jan-1998 08:45:00', 'DD-MON-YYYY HH:MI:SS'));
```

4. Query the `V$LOGMNR_CONTENTS` view.

   At this point, the `V$LOGMNR_CONTENTS` view is available for queries. You decide to find all of the changes made by user `joedevo` to the `salary` table. Execute the following `SELECT` statement:

```
SELECT SQL_REDO, SQL_UNDO FROM V$LOGMNR_CONTENTS WHERE USERNAME = 'joedevo' AND SEG_NAME = 'salary';
```

   For both the `SQL_REDO` and `SQL_UNDO` columns, two rows are returned (the format of the data display will be different on your screen). You discover that `joedevo` requested two operations: he deleted his old salary and then inserted a new, higher salary. You now have the data necessary to undo this operation.

```
SQL_REDO SQL_UNDO -------- -------- delete from SALARY insert into SALARY(NAME, EMPNO, SAL) where EMPNO = 12345 values ('JOEDEVO', 12345, 500) and NAME='JOEDEVO' and SAL=500; insert into SALARY(NAME, EMPNO, SAL) delete from SALARY values('JOEDEVO',12345, 2500) where EMPNO = 12345 and NAME = 'JOEDEVO' 2 rows selected and SAL = 2500;
```

5. End the LogMiner session.

   Use the `DBMS_LOGMNR.END_LOGMNR` procedure to finish the LogMiner session properly:

```
DBMS_LOGMNR.END_LOGMNR( );
```

Scenario 2: Using LogMiner to Calculate Table Access Statistics

In this example, assume you manage a direct marketing database and want to determine how productive the customer contacts have been in generating revenue for a 2-week period in January. Assume that you have already created the LogMiner dictionary and added the redo log files that you want to search (as demonstrated in the previous example). Take the following steps:

1. Start LogMiner and specify a range of times:

   ```
   EXECUTE DBMS_LOGMNR.START_LOGMNR( - STARTTIME => TO_DATE('07-Jan-2003 08:30:00','DD-MON-YYYY HH:MI:SS'), - ENDTIME =>
   TO_DATE('21-Jan-2003 08:45:00','DD-MON-YYYY HH:MI:SS'), - DICTFILENAME => '/usr/local/dict.ora');
   ```

2. Query the `V$LOGMNR_CONTENTS` view to determine which tables were modified in the time range you specified, as shown in the following example. (This query filters out system tables that traditionally have a `$` in their name.)

   ```
   SELECT SEG_OWNER, SEG_NAME, COUNT(*) AS Hits FROM V$LOGMNR_CONTENTS WHERE SEG_NAME NOT LIKE '%$' GROUP BY SEG_OWNER,
   SEG_NAME ORDER BY Hits DESC;
   ```

3. The following data is displayed. (The format of your display may be different.)

   ```
   SEG_OWNER SEG_NAME Hits --------- -------- ---- CUST ACCOUNT 384 UNIV EXECDONOR 325 UNIV DONOR 234 UNIV MEGADONOR 32 HR
   EMPLOYEES 12 SYS DONOR 12
   ```

   The values in the `Hits` column show the number of times that the named table had an insert, delete, or update operation performed on it during the 2-week period specified in the query. In this example, the `cust.account` table was modified the most during the specified 2-week period, and the `hr.employees` and `sys.donor` tables were modified the least during the same time period.

4. End the LogMiner session.

   Use the `DBMS_LOGMNR.END_LOGMNR` procedure to finish the LogMiner session properly:

   ```
   DBMS_LOGMNR.END_LOGMNR( );
   ```

Supported Datatypes, Storage Attributes, and Database and Redo Log File Versions

The following sections provide information about datatype and storage attribute support and the versions of the database and redo log files supported:

Supported Datatypes and Table Storage Attributes

LogMiner supports the following datatypes and table storage attributes:

- `CHAR`
- `NCHAR`
- `VARCHAR2` and `VARCHAR`
- `NVARCHAR2`
- `NUMBER`
- `DATE`
- `TIMESTAMP`
- `TIMESTAMP WITH TIME ZONE`
- `TIMESTAMP WITH LOCAL TIME ZONE`
- `INTERVAL YEAR TO MONTH`
- `INTERVAL DAY TO SECOND`
- `RAW`
- `CLOB`
- `NCLOB`
- `BLOB`
- `LONG`

- LONG RAW
- BINARY_FLOAT
- BINARY_DOUBLE
- Index-organized tables (IOTs), including those with overflows or LOB columns
- Function-based indexes

Support for LOB and LONG data types is available only for redo logs generated by a database with compatibility set to a value of 9.2.0.0 or higher.

Support for index-organized tables without overflow segment or with no LOB columns in them is available only for redo logs generated by a database with compatibility set to 10.0.0.0 or higher. Support for index-organized tables with overflow segment or with LOB columns is available only for redo logs generated by a database with compatibility set to 10.2.0.0.

Unsupported Datatypes and Table Storage Attributes

LogMiner does not support these datatypes and table storage attributes:

- BFILE datatype
- Simple and nested abstract datatypes (ADTs)
- Collections (nested tables and VARRAYs)
- Object refs
- XMLTYPE datatype
- Tables using table compression

Supported Databases and Redo Log File Versions

LogMiner runs only on databases of release 8.1 or later, but you can use it to analyze redo log files from release 8.0 databases. However, the information that LogMiner is able to retrieve from a redo log file depends on the version of the log, not the version of the database in use. For example, redo log files for Oracle9*i* can be augmented to capture additional information when supplemental logging is enabled. This allows LogMiner functionality to be used to its fullest advantage. Redo log files created with older releases of Oracle will not have that additional data and may therefore have limitations on the operations and datatypes supported by LogMiner.